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ABSTRACT

This document contains five learning activity packets (LAPs) that outline the study activities for the "engine" instructional area for an Auto Mechanics I course. The five LAPs cover the following topics: basic engine principles, cooling system, engine lubrication system, exhaust system, and fuel system. Each LAP contains a cover sheet that describes its purpose, an introduction, and the tasks included in the LAP; learning steps (checklist); pretest; and various assignment sheets. Materials are illustrated with line drawings. The LAPs are referenced to a curriculum guide for the Auto Mechanics I course. (KC)

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ED279809

CE-046478

Learning Activity Packets (LAPs)

Auto Mechanics I

Section C — Engine

- LAP #11 — Basic Engine Principles
- LAP #12 — Cooling System
- LAP #13 — Engine Lubrication System
- LAP #14 — Exhaust System
- LAP #15 — Fuel System

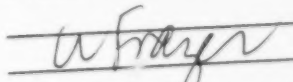
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**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

ENGINE

INSTRUCTIONAL UNIT

BASIC ENGINE PRINCIPLES
SECTION C--UNIT I

LEARNING ACTIVITY PACKET NO.

PREREQUISITE LAP(S)

11

1

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities for "Basic Engine Principles." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training.

INTRODUCTION: The course of study in this LAP will help the student become able to describe types of energy and calculate problems dealing with work, horsepower, torque, and engine displacement. The student should also be able to distinguish between internal and external combustion engines and to describe the operation of two-stroke and four-stroke cycle engines.

TASKS INCLUDED IN THIS LAP:

None

AUTO MECHANICS I
BASIC ENGINE PRINCIPLES

SECTION C--UNIT I

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step.

- ____ 1. Read Unit and Specific Objectives, page 1-C.
- ____ 2. Complete Basic Engine Principles Pre-Test, LAP page 5.
- ____ 3. Study The sections of the Information Sheet, pages 5-C through 14-C, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Refer To Step 23 of your Pre-Test. If additional study is indicated for any of Sections I (Part I) - VII, continue to Step 5. Otherwise, proceed to Step 7.
- ____ 5. Do LAP Assignment Sheet #1, LAP page 17.
- ____ 6. Do LAP Assignment Sheet #2, LAP page 21.
- ____ 7. Refer To Step 23 of your Pre-Test. If additional study is indicated for Section VIII, continue to Step 8. Otherwise, proceed to Step 11.
- ____ 8. Do Assignment Sheet #1--Calculate Work, page 45-C.
- ____ 9. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Step 11. Otherwise, continue to Step 10.

- ____ 10. Do LAP Assignment Sheet #3, LAP page 25.
- ____ 11. Refer To Step 23 of your Pre-Test. If additional study is indicated for Section IX, continue to Step 12. Otherwise, proceed to Step 15.
- ____ 12. Do Assignment Sheet #2--Calculate Horsepower, page 47-C.
- ____ 13. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Step 15. Otherwise, continue to Step 14.
- ____ 14. Do LAP Assignment Sheet #4, LAP page 27.
- ____ 15. Refer To Step 23 of your Pre-Test. If additional study is indicated for Section X, continue to Step 16. Otherwise, proceed to Step 19.
- ____ 16. Do Assignment Sheet #3--Calculate Torque, page 49-C.
- ____ 17. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Step 19. Otherwise, continue to Step 18.
- ____ 18. Do LAP Assignment Sheet #5, LAP page 29.
- ____ 19. Refer To Step 23 of your Pre-Test. If additional study is indicated for any of Sections I (Part II) or XI - XVII, continue to Step 20. Otherwise, proceed to Step 22.
- ____ 20. Do LAP Assignment Sheet #6, LAP page 31.

- ____ 21. Do LAP Assignment Sheet #7, LAP page 37.
- ____ 22. Refer To Step 23 of your Pre-Test. If additional study is indicated for Section XVIII, continue to Step 23. Otherwise, proceed to Step 26.
- ____ 23. Do Assignment Sheet #4--Calculate Cubic Inch Displacement, page 51-C.
- ____ 24. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, proceed to Step 26. Otherwise, continue to Step 25.
- ____ 25. Do LAP Assignment Sheet #8, LAP page 41.
- ____ 26. Refer To Step 23 of your Pre-Test. If additional study is indicated for any of Sections XIX - XXII, continue to Step 27. Otherwise, proceed to Step 29.
- ____ 27. Do LAP Assignment Sheet #9, LAP page 45.
- ____ 28. Do LAP Assignment Sheet #10, LAP page 49.
- ____ 29. Review Information Sheet (page 5-C) and Assignment Sheets.
- ____ 30. Take Basic Engine Principles Unit I Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional study requirements and possible re-testing with your instructor.

BASIC ENGINE PRINCIPLES
UNIT I

PRE-TEST

NAME _____ SCORE _____

1. Match the terms on the right to their correct definitions. Definitions continue on next page.

- | | | | |
|----------|--|-----|------------------|
| _____ a. | Abbreviation for Power Surge Indicator; a device for measuring excessive engine compression | 1. | Force |
| _____ b. | Stored energy | 2. | Work |
| _____ c. | Transmission and control of motion through the use of gears, pulleys, shafts, and other mechanical devices | 3. | Energy |
| _____ d. | Force necessary to change an object at rest into a moving object | 4. | Potential energy |
| _____ e. | Resistance to relative motion between two bodies in contact | 5. | Kinetic energy |
| _____ f. | Ability to do work | 6. | Power |
| _____ g. | Any agent that produces or tends to produce motion | 7. | Horsepower |
| _____ h. | Force necessary to change kinetic energy to mechanical energy | 8. | Torque |
| _____ i. | Force produced by a reciprocating body | 9. | Friction |
| _____ j. | Rate at which work is done | 10. | Mechanical power |
| _____ k. | Movement of electrical energy from a point of high charge to a point of low charge | 11. | PSI |
| _____ l. | Results of force overcoming a resistance over a definite distance | | |
| _____ m. | Measurement of turning effort | | |
| _____ n. | Energy in motion | | |
| _____ o. | To exercise restraining or directing influence over working forces | | |

- ____ p. Abbreviation for pounds per square inch; most common unit for measuring pressure
- ____ q. Measurement of work accomplished in a given period of time

Part II (Definitions on next page.)

- | | |
|---|---------------------------|
| ____ a. Relaying of a work force | 1. Reciprocating motion |
| ____ b. Top dead center | 2. Cycle |
| ____ c. Rotating motion | 3. Control |
| ____ d. Combustion indicator device | 4. Transmission |
| ____ e. Total volume of air-fuel compression by the piston in traveling from TDC to BDC | 5. TDC |
| ____ f. Action or operation of burning | 6. BDC |
| ____ g. Backfire deadening combustion | 7. Stroke |
| ____ h. To exercise restraining or directing influence over working forces | 8. Bore |
| ____ i. Comparison between the actual volume of air-fuel mixture drawn in on the intake stroke and the volume that would be drawn in if the cylinder were to be completely filled | 9. Displacement |
| ____ j. Total space between the piston at BDC and the cylinder head | 10. CID |
| ____ k. Total displacement constant | 11. Clearance volume |
| ____ l. Diameter of the cylinder | 12. Compression ratio |
| ____ m. Cubic inch displacement | 13. Combustion |
| ____ n. Series of events or operations that happen regularly and lead back to the starting point | 14. Volumetric efficiency |
| ____ o. Bottom dead center | |
| ____ p. Total space between the piston at TDC and the cylinder head | |

- ____ q. Total volume of compression space for all cylinders at whatever stroke position they may be at
- ____ r. Back-and-forth motion
- ____ s. Ratio between length of stroke and depth of cylinder
- ____ t. Distance the piston moves when traveling from TDC to BDC

2. Describe the characteristics of energy by choosing the most correct choice for each of the following statements.

a. Energy is _____ present.

- 1. usually
- 2. ever
- 3. becoming less
- 4. never

b. Energy cannot be _____.

- 1. converted or transformed
- 2. produced from matter
- 3. stored or released
- 4. created or destroyed

c. Energy can be changed from _____ to _____.

- 1. one kind, another
- 2. small amounts, large amounts
- 3. solid, liquid
- 4. liquid, gas

3. List six types of energy.

- a.
- b.
- c.
- d.
- e.
- f.

4. List two forms of available by giving at least three examples of each form.

a. Potential

- 1.
- 2.
- 3.

b. Kinetic

- 1.
- 2.
- 3.

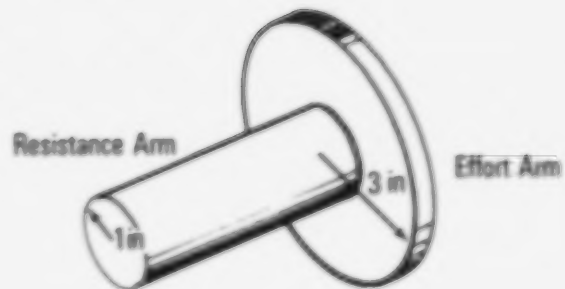
5. List three types of motion by placing an "X" beside each correct choice.

- ___ a. Spiral
- ___ b. Linear
- ___ c. Rotary
- ___ d. Vertical
- ___ e. Horizontal
- ___ f. Reciprocating

6. Identify the following simple machines.



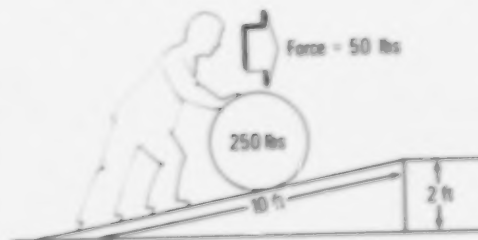
a. _____



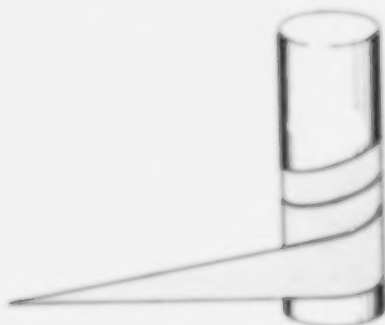
b. _____



c. _____



d. _____



e. _____

f. _____

7. List three uses of simple machines by describing what simple machines can do to each of the following aspects of work.

a. Force -- _____

b. Direction -- _____

c. Speed -- _____

8. Calculate the following problem using the formula for work.

$$W = F \times D$$

A 180-pound man lifts a 19-pound flywheel to a height of four feet to place it on a bench. If it takes him 1.4 seconds and he exerts a force of 19 pounds, how much work has he done?

Answer: _____

9. Calculate the following problem using the formula for horsepower.

$$HP = \frac{F \times D}{\text{Time (sec.)} \times 550}$$

A 120-pound woman walks up an incline 30 feet long which rises to a height of 6 feet. If it takes her 15 seconds and requires a force of 40 pounds, what horsepower is produced?

Answer: _____

10. Calculate the following problem using the formula for torque.

$$T = F \times R$$

What is the torque if a force of 50 pounds is applied to a wrench 18 inches long for 4 seconds?

Answer: _____

11. Describe the basic principle of the heat engine.

12. Explain the general difference between an internal and an external combustion engine.

13. Describe the function of these engine parts.

a. Valve -- _____

b. Crankshaft -- _____

c. Piston -- _____

- d. Cylinder -- _____

- e. Connecting rod -- _____

- f. Camshaft -- _____

14. Describe the process by which chemical energy is converted to rotary motion in the internal combustion engine.
15. Discuss the four-stroke operation of most automobile engines. Be sure to clearly identify each stroke and tell what happens during that stroke.

16. Discuss the following features of valve timing.

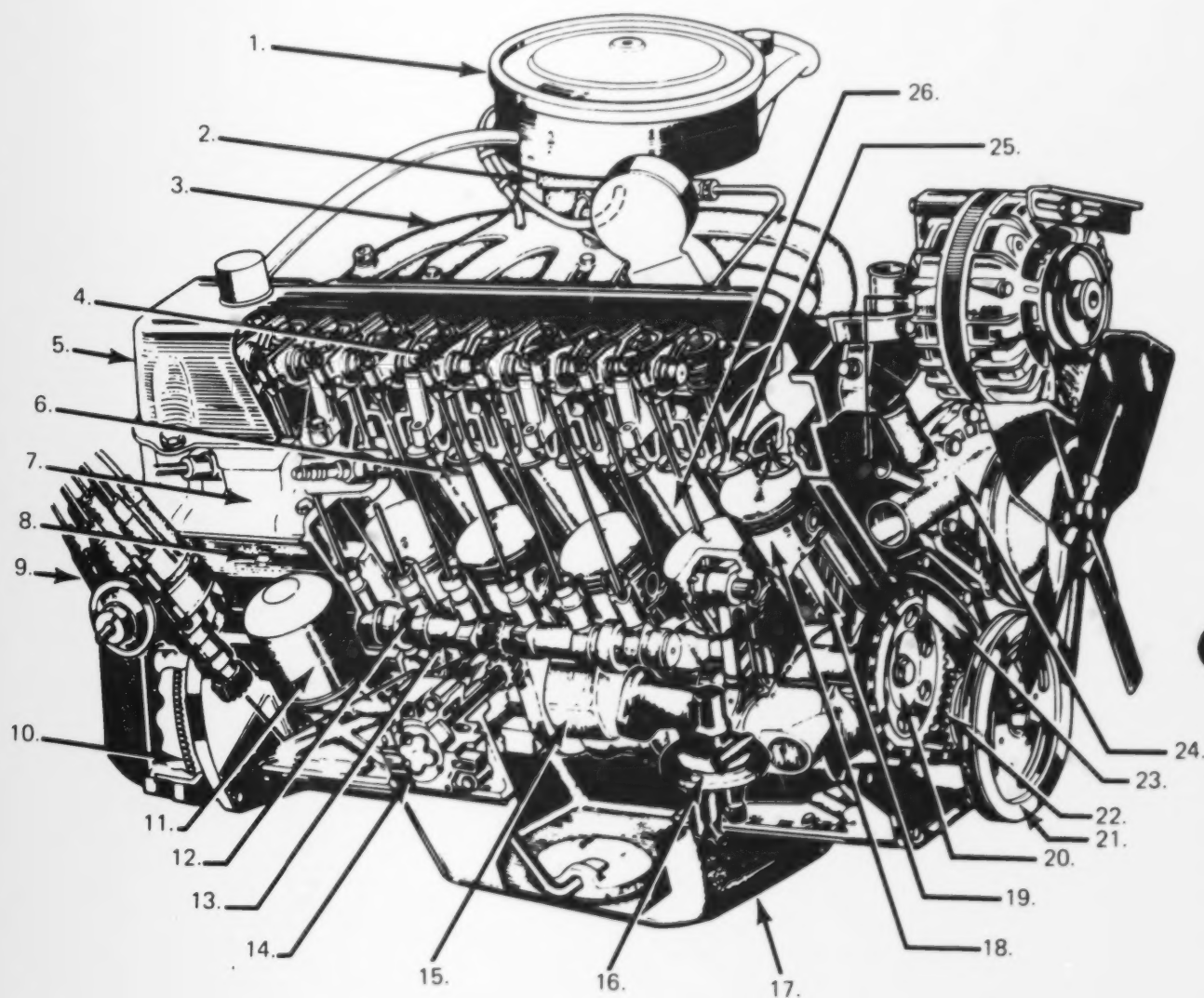
- a. Describe the opening and closing of the intake valve in relation to the strokes.
- b. Describe the opening and closing of the exhaust valve in relation to the strokes.
- c. Explain what is meant by "valve overlap."

17. Discuss the operation of the two-stroke cycle engine.

18. State the formula for calculating engine displacement in cubic inches.

19. Explain the effect of increasing the compression ratio.

20. Identify the components of the engine illustrated below.



- | | |
|-----------|-----------|
| 1. _____ | 14. _____ |
| 2. _____ | 15. _____ |
| 3. _____ | 16. _____ |
| 4. _____ | 17. _____ |
| 5. _____ | 18. _____ |
| 6. _____ | 19. _____ |
| 7. _____ | 20. _____ |
| 8. _____ | 21. _____ |
| 9. _____ | 22. _____ |
| 10. _____ | 23. _____ |
| 11. _____ | 24. _____ |
| 12. _____ | 25. _____ |
| 13. _____ | 26. _____ |

21. Distinguish between gasoline and diesel engines. Place a "G" in front of the statements which describe gasoline engines. Place a "D" in front of the statements which describe diesel engines.

- _____ a. Fuel mixture ignited by electrical spark
- _____ b. Fuel mixture ignited by heat created by extremely high compression
- _____ c. Low volatile fuel used
- _____ d. Very high compression compared to other type of engine
- _____ e. Highly volatile fuel used
- _____ f. Compression lower than other type of engine.

22. Discuss the purposes of using a heavy flywheel.

23. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|------------------------|-------------|
| _____ I (Part I: A-K) | _____ XII |
| _____ I (Part II: L-Z) | _____ XIII |
| _____ II | _____ XIV |
| _____ III | _____ XV |
| _____ IV | _____ XVI |
| _____ V | _____ XVII |
| _____ VI | _____ XVIII |
| _____ VII | _____ XIX |
| _____ VIII | _____ XX |
| _____ IX | _____ XXI |
| _____ X | _____ XXII |
| _____ XI | _____ XXIII |

You came here from LAP Step 2. If any of the above study areas is checked,

continue to LAP Step 3. Otherwise, proceed to the next assigned Learning Activity Packet.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #1--ENERGY AND SIMPLE MACHINES

NAME _____ SCORE _____

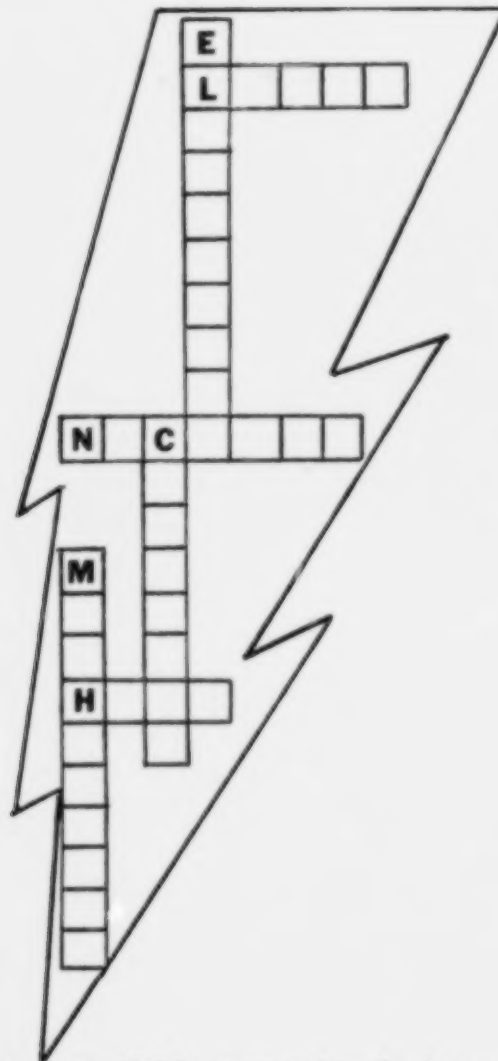
1. Match the terms on the right to their correct definitions.

- | | |
|---|----------------------|
| _____ a. Ability to do work | 1. Force |
| _____ b. Rate at which work is done | 2. Work |
| _____ c. Measurement of turning effort | 3. Energy |
| _____ d. Any agent that produces or tends to produce motion | 4. Potential energy |
| _____ e. Abbreviation for pounds per square inch; most common unit for measuring pressure | 5. Kinetic energy |
| _____ f. Energy in motion | 6. Power |
| _____ g. Resistance to relative motion between two bodies in contact | 7. Horsepower |
| _____ h. Results of force overcoming a resistance over a definite distance | 8. Torque |
| _____ i. Transmission and control of motion through the use of gears, pulleys, shafts, and other mechanical devices | 9. Friction |
| _____ j. Measurement of work accomplished in a given period of time | 10. PSI |
| _____ k. Stored energy | 11. Mechanical power |

2. Describe characteristics of energy by completing the following statements.

- a. Energy is ever _____.
- b. It cannot be _____ or _____.
- c. It can be changed from one _____ to another.

3. Name types of energy by completing the names below.



4. List two forms of available energy by placing an "X" beside the correct answers.

- ☐ a. Caustic
- ☐ b. Potential
- ☐ c. Director
- ☐ d. Alternating
- ☐ e. Kinetic
- ☐ f. Initial

5. Name types of motion by unscrambling the letters in each word below to produce the correct name.

- a. PRECCIGATION

b. TORRAY

c. RENAIL

6. Identify the following simple machines by selecting the correct names from the list below

Lever
Wheel and axle
Pulley

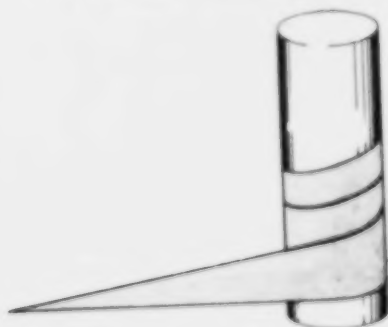
Inclined plane
Screw
Wedge



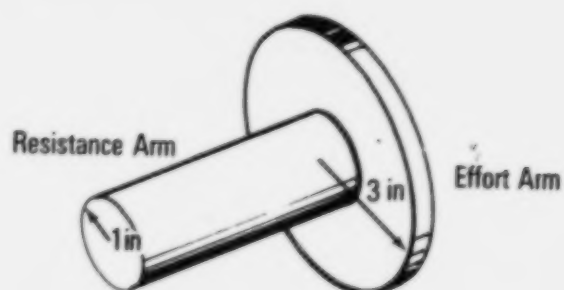
a. _____



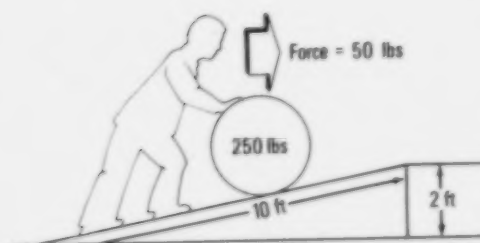
c. _____



e. _____



b. _____



d. _____



21^f. _____

7. List three uses of simple machines by placing an "X" beside each correct statement.

- ☐ a. Change type of energy
- ☐ b. Change speed
- ☐ c. Decrease power
- ☐ d. Change direction
- ☐ e. Increase power
- ☐ f. Change heat output

8. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- ☐ I (Part I: A-K)
- ☐ II
- ☐ III
- ☐ IV

- ☐ V
- ☐ VI
- ☐ VII

If none of the above areas is checked, proceed to LAP Step 7. Otherwise, study the required areas and then continue to LAP Step 6.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #2--ENERGY AND SIMPLE MACHINES

NAME _____ SCORE _____

1. Define the following terms.

- a. Energy -- _____

- b. Force -- _____

- c. Friction -- _____

- d. Horsepower -- _____

- e. Kinetic energy -- _____

- f. Potential energy -- _____

- g. Power -- _____

- h. Mechanical power -- _____

- i. PSI -- _____

- j. Torque -- _____

- k. Work -- _____

2. Discuss the characteristics of energy.

3. List six types of energy.

- a.
- b.
- c.
- d.
- e.
- f.

4. List two forms of available energy.

- a.
- b.

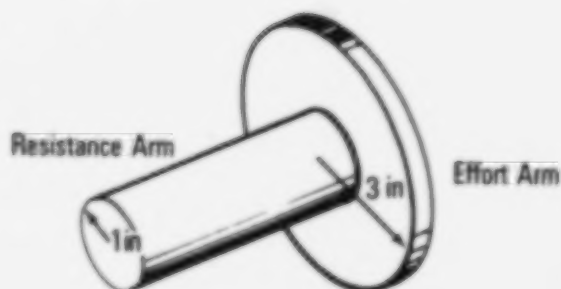
5. List three types of motion.

- a.
- b.
- c.

6. Identify the following simple machines.



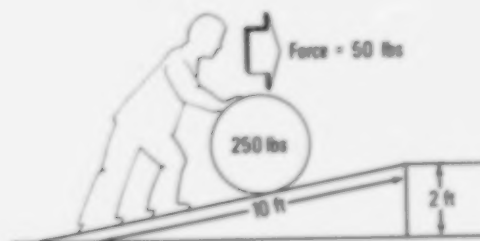
a. _____



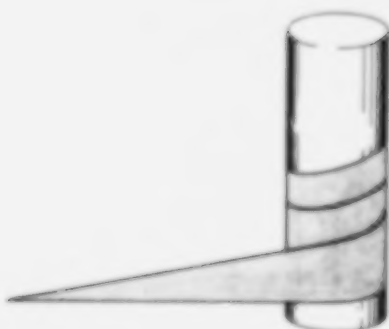
b. _____



c. _____



24. _____



e. _____



f. _____

7. List three uses of simple machines.

- a.
- b.
- c.

8. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 7. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 7.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #3--CALCULATE WORK

NAME _____ SCORE _____

1. Use the formula for work to calculate the following problems.

$$W = F \times D$$

- a. A conveyor belt moves an engine block along an assembly line. If the block weighs 85 pounds, how much work is required to move the part 100 feet?

Answer: _____

- b. If a 165-pound exerts 3000 foot-pounds of work to move a 100-pound ignition diagnostic machine 100 feet, how much work is required to move the same equipment to a second vehicle 235 feet from the first test site?

Answer: _____

- c. If it takes 490 foot-pounds of work to move a transmission 7 feet, how much force is involved in moving the part?

Answer: _____

2. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 11. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 11.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #4--CALCULATE HORSEPOWER

NAME _____ SCORE _____

1. Use the formula for horsepower to calculate the following problems

$$\text{HP} = \frac{\text{F} \times \text{D}}{\text{Time (sec.)} \times 550}$$

- a. It takes 1100 pounds of force to move a 2600-pound car along a track. If the car travels one mile in one minute and fifteen seconds, what horsepower is being developed by the car?

Answer: _____

- b. In moving an engine hoist to a vehicle, 3200 foot-pounds of work was accomplished. If it took 8 seconds to move the device, how much horsepower was developed?

Answer: _____

- c. After the hoist was secured, the mechanics lifted the 620-pound engine clear of the car. If the engine had to be raised four feet to clear the fender and it took thirty seconds to hoist the engine, how much horsepower was developed?

Answer: _____

2. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 15. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 15.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #5--CALCULATE TORQUE

NAME _____ SCORE _____

1. Use the formula for torque to calculate the following problems.

$$T = F \times R$$

- a. A 10-inch wrench is used to turn a bolt with 30 pounds of force. What torque is developed?

Answer: _____

- b. A gear two feet in diameter produces a force of 200 pounds. What is the torque?

Answer: _____

- c. A pulley with a six-inch radius develops a torque of 40 pound-feet. How much force is being applied to the pulley?

Answer: _____

2. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 19. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 19.

BASIC ENGINE PRINCIPALS
UNIT I

LAP ASSIGNMENT SHEET #6--ENGINES

NAME _____ SCORE _____

1. Match the terms on the right to their correct definitions.

- | | |
|--|---------------------------|
| _____ a. Top dead center | 1. Reciprocating motion |
| _____ b. Series of events or operations that happen regularly and lead back to the starting point | 2. Cycle |
| _____ c. Ratio of whole cylinder volume to clearance volume | 3. Control |
| _____ d. Distance the piston moves when traveling from TDC to BDC | 4. Transmission |
| _____ e. Action or operation of burning | 5. TDC |
| _____ f. Relaying of a working force | 6. BDC |
| _____ g. Back-and-forth motion | 7. Stroke |
| _____ h. Diameter of the cylinder | 8. Bore |
| _____ i. Comparison between the actual volume or air-fuel mixture drawn in on the intake stroke and the volume that would be drawn in if the cylinder were to be completely filled | 9. Displacement |
| _____ j. Cubic inch displacement | 10. CID |
| _____ k. Total volume of air-fuel compressed by the piston in traveling from BDC to TDC | 11. Volume |
| _____ l. To exercise restraining or directing influence over working forces | 12. Clearance volume |
| _____ m. Bottom dead center | 13. Compression ratio |
| _____ n. Total space between the piston at BDC and the cylinder head | 14. Combustion |
| _____ o. Total space between the piston at TDC and the cylinder head | 15. Volumetric efficiency |

2. Describe the characteristic of a heat engine by completing the following statement.

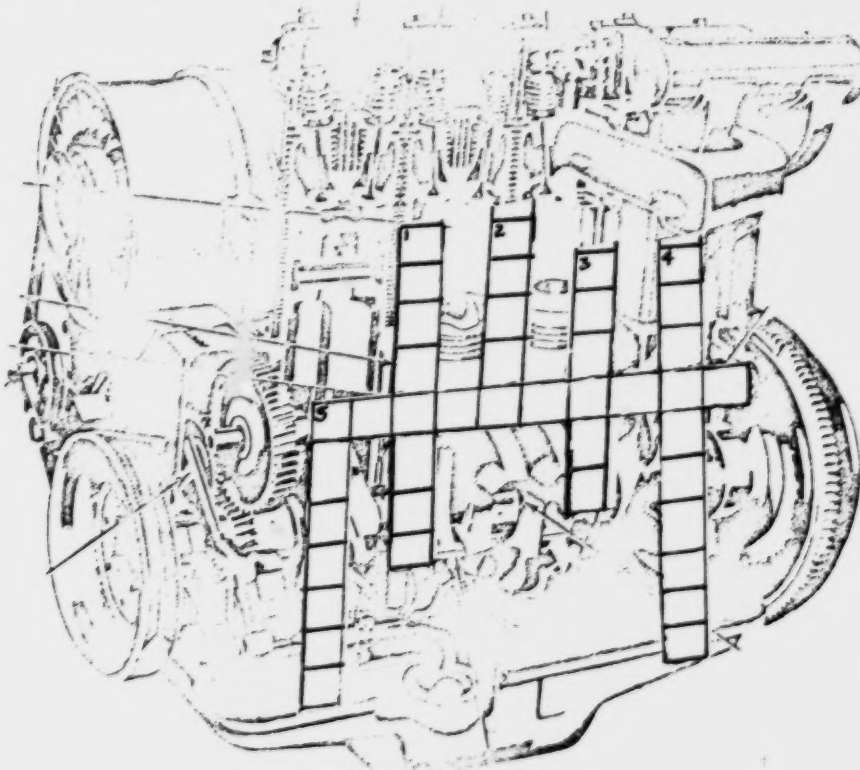
The heat engine converts heat into usable _____ in the form of _____.

3. Distinguish between external and internal combustion engines by completing each of the following statements and labelling them correctly as describing either external or internal combustion engines.

_____ a. Fuel is burned _____ the engine to produce _____ energy which the engine converts to _____.

_____ b. Fuel produces _____ energy _____ the engine and is transmitted to the engine by _____ or other means to power the engine which converts _____ energy to _____.

4. Match the parts of a basic internal combustion engine by completing the crossword puzzle below.



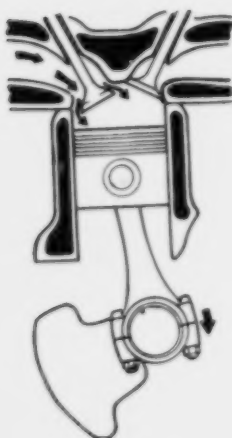
Across

5. _____ rod -- Straight rod with one end connected to a pivot in the piston so lower end can swing with the rotation of the crankshaft.

Down

1. Hollow tube closed at one end.

2. Movable plug to open and close the cylinder in order to let in air-fuel mixture and to remove the burned fuel from the cylinder.
 3. Cylindrical object which slides in the tube, fitting tightly to seal other end of tube.
 4. Main shaft of an engine which in conjunction with connecting rods changes reciprocating motion of pistons into rotary motion.
 5. Shaft on which lobes (humps) and bearing journals are located; usually used to open the valves.
5. Describe the process for converting chemical energy into rotary motion in the internal combustion engine. Number the following statements to show the correct sequence of the process.
- ___ a. Expansion of the burning gases pushes piston down the cylinder.
 - ___ b. Heat energy causes the cylinder gases to expand.
 - ___ c. Gasoline and air are introduced into the upper end of the cylinder.
 - ___ d. Downward motion of piston transmits force to the crankshaft through the connecting rod to produce rotary motion.
6. Describe the operation of the four-stroke cycle engine. Identify the strokes illustrated below and describe what happens in each stroke.
- a. _____

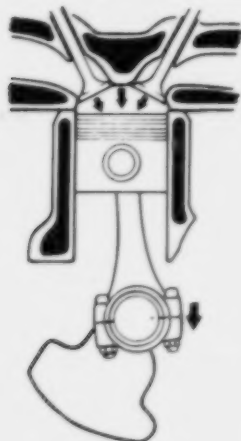


1.

2.

3.

b.

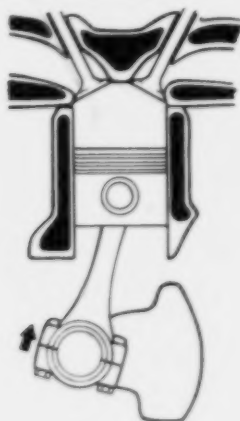


1.

2.

3.

c.

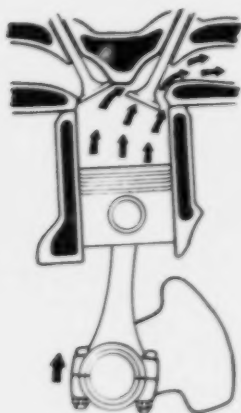


1.

2.

3.

d.



1.

2.

3.

7. Discuss specific valve timing and valve overlap by completing the following statements.

- a. _____ valve -- Opens approximately _____ degrees before the intake stroke begins and remains open through intake stroke and _____ degrees into compression stroke.
- b. _____ valve -- Opens approximately _____ degrees before the exhaust stroke begins and remains open through exhaust stroke and _____ degrees into intake stroke.
- c. Valve _____ -- Both intake and exhaust valves are partially open; the _____ valve is starting to open while the _____ valve is not yet closed.

8. Describe the operation of the two-stroke cycle engine by numbering the following steps in the sequence of operation. Assume that the piston is at BDC and number the remaining steps.

- _____ a. Air-fuel mixture is introduced into the cylinder when piston is at the bottom.
- _____ b. Air-fuel mixture is ignited as piston reaches TDC.
- _____ c. As piston reaches the bottom of the cylinder again, burned gases are allowed to escape through one side of the cylinder or exhaust valve as a fresh charge of fuel and air is introduced in the other side.
- _____ d. Expanding gases push the piston down the cylinder forcing the crankshaft to rotate.
- _____ e. Piston moves up the cylinder, compressing the mixture.

9. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

_____ I (Part II: L-Z)
 _____ XI
 _____ XII
 _____ XIII

_____ XIV
 _____ XV
 _____ XVI

If any of the above areas is checked, study the sections required and then continue to LAP Step 21. Otherwise, proceed to LAP Step 22.

BASIC ENGINE PRINCIPLES
UNIT I
LAP ASSIGNMENT #7--ENGINES

NAME _____ SCORE _____

1. Define the following terms.

- a. BDC -- _____

- b. Bore -- _____

- c. CID -- _____

- d. Combustion -- _____

- e. Control -- _____

- f. Clearance volume -- _____

- g. Compression ratio -- _____

- h. Cycle -- _____

- i. Displacement -- _____

- j. Stroke -- _____

- k. TDC -- _____

- l. Transmission -- _____

 - m. Reciprocating motion -- _____

 - n. Volume -- _____

 - o. Volumetric efficiency -- _____

2. Describe the characteristic of a heat engine.
3. Distinguish between internal and external combustion engines by placing an "E" beside the statement below which describes the external combustion engine.
- _____ a. Fuel produces heat energy outside the engine and is transmitted to the engine by water or other means to power the engine which converts heat energy to motion.
 - _____ b. Fuel is burned inside the engine to produce heat energy which the engine converts to motion.
4. Describe the function of each of the basic internal combustion engine parts listed below.
- a. Camshaft -- _____

 - b. Crankshaft -- _____

 - c. Connecting rod -- _____

 - d. Cylinder -- _____

e. Piston -- _____

f. Valve -- _____

5. Describe the process for converting chemical energy into rotary motion.

6. Describe the operation of the four-stroke cycle engine.

7. Discuss valve timing and overlap.

8. Describe the operation of the two-stroke cycle engine.

9. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 22. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 22.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #8--CALCULATE DISPLACEMENT

NAME _____ SCORE _____

DIRECTIONS: Calculate the engine displacement in each problem. Show all your work and round your answers to the nearest whole number. Use 3.14 for π . The formula for displacement is

$$\text{CID} = \frac{\pi \times \text{Bore}^2 \times \text{Stroke}}{4}$$

$$\text{Total CID} = \text{CID} \times \text{Number of Cylinders}$$

1. What is the CID of a cylinder with a 5-inch bore and 4-inch stroke?

Answer: _____

2. What is the total CID of a six-cylinder engine with a 4.25-inch bore and a 4.5-inch stroke?

Answer: _____

3. What is the CID of an eight-cylinder engine with a 3.89 inch bore and a stroke of 4.63 inches?

Answer: _____

4. What is the displacement of a four-cylinder engine with a 88-millimeter bore and a stroke of 73 millimeters?

Answer: _____

5. What is the bore of an eight-cylinder engine with a 352 CID and a stroke of 3.5 inches?

Answer: _____

6. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 26.

BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #9--ENGINE DESIGN

NAME _____ SCORE _____

1. Explain the results of increasing compression ratio by completing the statements below. The answers are hidden in the following word search. Words go horizontally, vertically, and diagonally, either forward or backward.

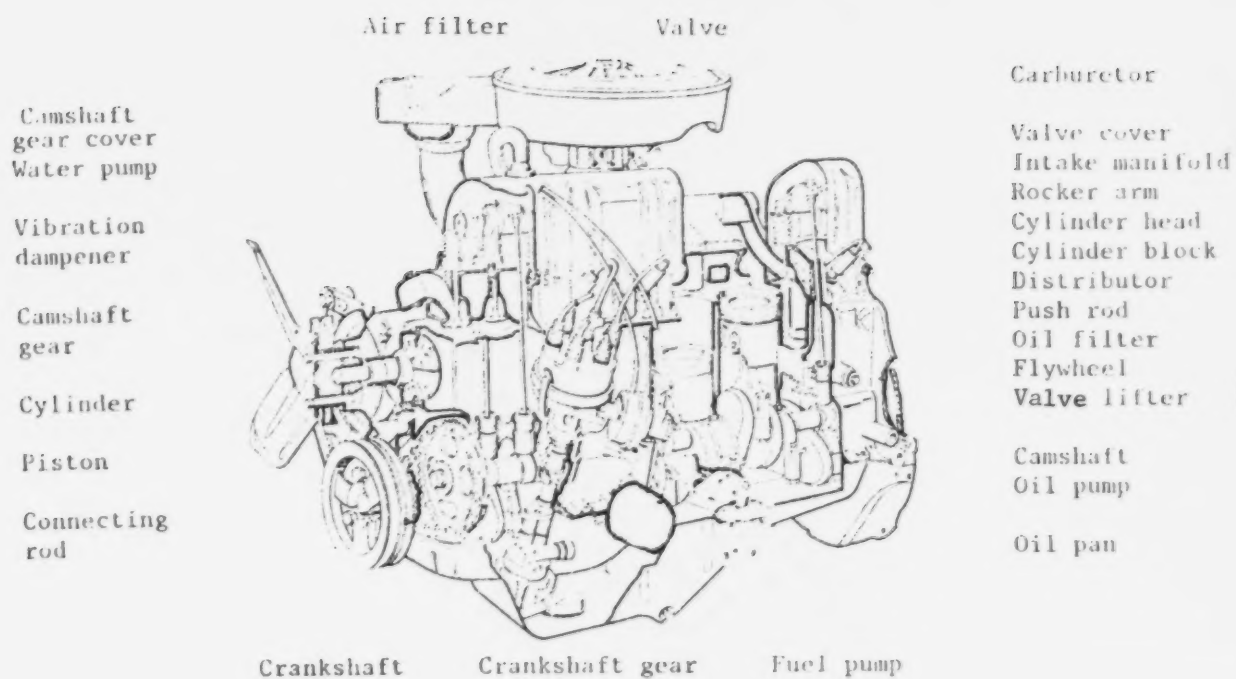
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C N O I T A N O T E D
A O Y T N Q W S H H B
B I M K C O N K I J C
E P O P L R M G K V U
X O N O R A H I C E Y
H G O W S E R Q J N M
A T C E R K S N Z A U
U V E R D O D S G T Z
S E S A E R C N I C W
T P F F E Y H L X O E
P O L L U T A N T S N

```

- a. _____ increases as the _____ ratio increases.
- b. Fuel _____ increases as compression ratio _____.
- c. Higher _____ fuel is required as the compression ratio is increased to prevent engine _____ due to _____.
- d. _____ compression ratios produce more _____ gas _____.

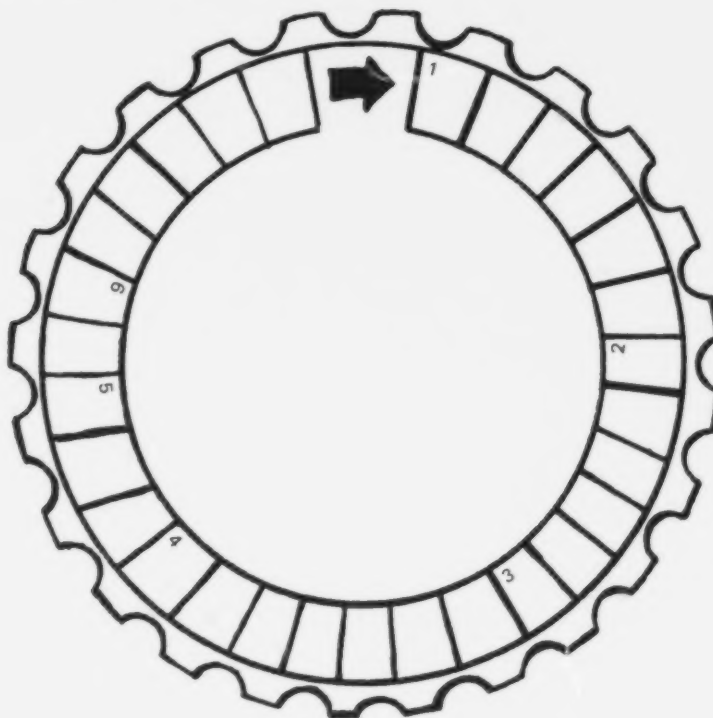
2. Identify the components of the automobile engine illustrated below by drawing a line from each term to its correct location.



3. Distinguish between gasoline and diesel engines by labeling one column of the following chart "Diesel" and one column "Gasoline"

a. Fuel mixture ignited by electrical spark	a. Fuel mixture ignited by heat created by extremely high compression
b. Highly volatile gasoline used for fuel	b. Low volatile oil used for fuel
c. Lower compression ratio	c. Very high compression

4. Discuss the purposes of a heavy fly wheel by working the puzzle below. The words necessary to complete the statements about flywheels will provide answers for the puzzle. In the puzzle, the last letter of one word becomes the first letter of the next word.



- Smooth out (two) of the power (one).
- Maintain crankshaft (six) between power strokes.
- Develop kinetic energy when (three).
- Provide (four) teeth on outer (five) for starting motor operation.

5. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____XIX
____XX

____XXI
____XXII

If any of the above areas is checked, study the required sections and then continue to LAP Step 28. Otherwise, proceed to LAP Step 29.

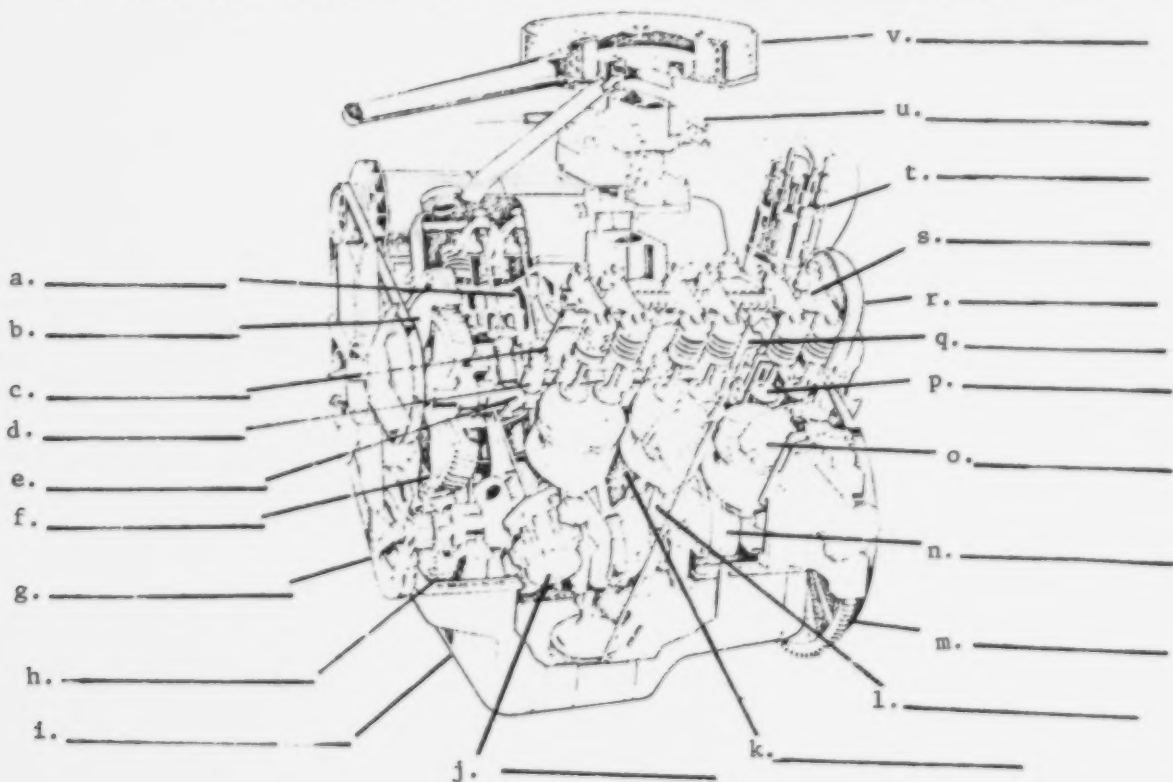
BASIC ENGINE PRINCIPLES
UNIT I

LAP ASSIGNMENT SHEET #10--ENGINE DESIGN

NAME _____ SCORE _____

1. Explain the results of increasing the compression ratio.

2. Identify the components of the automobile engine illustrated below.



3. Distinguish between gasoline and diesel engine by explaining the differences in fuel used, means of igniting fuel, and compression ratio.

4. Discuss the purposes of a heavy flywheel.

5. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 29. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 29.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS
for AUTO MECHANICS I**

MAJOR INSTRUCTIONAL AREA

ENGINE

INSTRUCTIONAL UNITCOOLING SYSTEM
SECTION C--UNIT II**LEARNING ACTIVITY PACKET NO.****12****PREREQUISITE LAP(S)**

1, 2, 11

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Cooling System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to describe the construction and operation of the cooling system and to perform certain tasks required in the maintenance of the cooling system.

TASKS INCLUDED IN THIS LAP:

1. Remove, check, and replace a thermostat.
2. Remove and replace a water pump.
3. Remove and replace a radiator.
4. Pressure test the cooling system.
5. Remove, inspect, and replace V-belts.
6. Test antifreeze solution.

AUTO MECHANICS I
COOLING SYSTEM

SECTION C--UNIT II

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, pages 73-C and 74-C.
- ____ 2. Complete Cooling System Pre-Test, LAP page 7.
- ____ 3. Study The Sections of the Information Sheet, pages 77-C through 80-C, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 13.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 19.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Remove, check, and replace a thermostat (9).	_____	_____
____ b.	Remove and replace a water pump (15).	_____	_____
____ c.	Remove and replace a radiator (21).	_____	_____
____ d.	Pressure test the cooling system (27).	_____	_____

- ____ e. Remove, inspect, and replace V-belts (33). _____
- ____ f. Test antifreeze solution (39). _____
- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 45. Otherwise, continue to Step 8.
- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Remove, Check, and Replace a Thermostat, page 97-C.
- ____ 10. Watch Slide/tape presentation "Remove, Check, and Replace a Thermostat" (C-II-1).
- ____ 11. Do Job Sheet #1--Remove, Check, and Replace a Thermostat.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-1 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.

- ____ 15. Study Job Sheet #2--Remove and Replace a Water Pump, page 101-C.
- ____ 16. Watch Slide/tape presentation "Remove and Replace a Water Pump" (C-II-2).
- ____ 17. Do Job Sheet #2--Remove and Replace a Water Pump.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Remove and Replace a Radiator, page 103-C.
- ____ 22. Watch Slide/tape presentation "Remove and Replace a Radiator" (C-II-3).
- ____ 23. Do Job Sheet #3--Remove and Replace a Radiator.
- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.

- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 27. Study Job Sheet #4--Pressure Test the Cooling System, page 105-C.
- ____ 28. Watch Slide/tape presentation "Pressure Test the Cooling System." (C-II-4).
- ____ 29. Do Job Sheet #4--Pressure Test the Cooling System.
- ____ 30. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and proceed to Step 32. Otherwise, repeat Steps 27-29 and then go to Step 31.
- ____ 31. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and continue to Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6d and continue to Step 32.
- ____ 32. Refer To Step 6e. If this task has been initialed, proceed to Step 38. Otherwise, continue to Step 33.
- ____ 33. Study Job Sheet #5--Remove, Inspect, and Replace V-Belts, page 109-C.
- ____ 34. Watch Slide/tape presentation "Remove, Inspect, and Replace V-Belts" (C-II-5).

- ____ 35. Do Job Sheet #5--Remove, Inspect, and Replace V-Belts.
- ____ 36. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and proceed to Step 38. Otherwise, repeat Steps 33-35 and then go to Step 37.
- ____ 37. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and continue to Step 38. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6e and continue to Step 38.
- ____ 38. Refer To Step 6f. If this task has been initialed, proceed to Step 44. Otherwise, continue to Step 39.
- ____ 39. Study Job Sheet #5--Test Antifreeze Solution, page 111-C.
- ____ 40. Watch Slide/tape presentation "Test Antifreeze Solution" (C-II-6).
- ____ 41. Do Job Sheet #6--Test Antifreeze Solution.
- ____ 42. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6f and proceed to Step 44. Otherwise, repeat Steps 39-41 and then go to Step 43.
- ____ 43. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6f and continue to Step 44. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6f and continue to Step 44.

- ____ 44. Refer To Step 6. If all tasks have been initialed, continue to Step 45. Otherwise, refer to the step number in parentheses after the unsigned task.
- ____ 45. Review Information Sheet (page 77-C).
- ____ 46. Take Cooling System Unit II Test (see your instructor). If you score 85 percent or more, continue to the next assigned Learning Activity Packet. If additional study is required, discuss additional study requirements and possible re-testing.

COOLING SYSTEM
UNIT II

PRE-TEST

NAME _____ SCORE _____

DIRECTIONS: This test is to determine how much you already know about the cooling system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

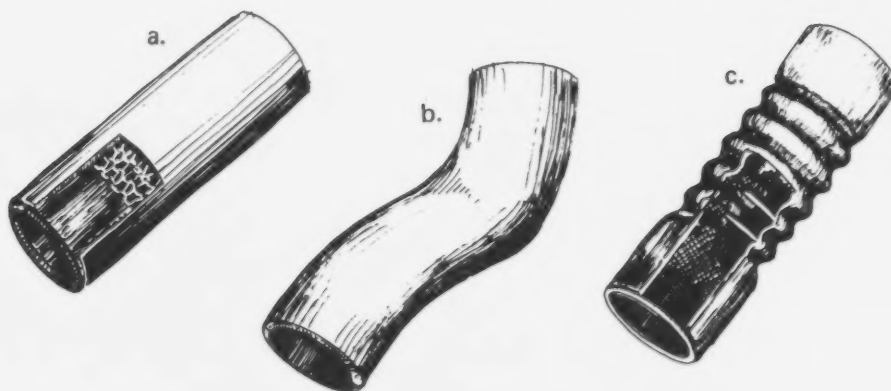
1. Describe the purpose of the cooling system.

2. Match the terms on the right to their correct definitions. Definitions continue on next page.

_____ a. Device generally mounted on the water pump hub assembly used to pull a large volume of air through the openings in the radiator core	1. Water pump
_____ b. Covering used to protect water pump	2. Water jacket
_____ c. Heat-controlled valve in the cooling system used to regulate the flow of coolant between the cylinder block and radiator	3. Radiator
_____ d. Belt turned by a pulley on the front of the crankshaft used to drive the water pump, fan, and other engine accessories	4. Fan
_____ e. A variable-speed belt used to power accessories such as power steering pumps	5. Shroud
_____ f. Centrifugal pump mounted at the front of the cylinder block to circulate the coolant throughout the cooling system	6. Thermostat
_____ g. Passage through the block and cylinder head that allows the coolant to circulate around the cylinders, valves, and combustion chambers	7. Pressure cap
	8. Radiator hose
	9. V-belt

- _____ h. Cap which increases the pressure within the cooling system several pounds per square inch, allowing the coolant to circulate at higher temperatures without evaporation or surge loss
 - _____ i. Device used to check belt tension on drive belts
 - _____ j. Device for holding a considerable volume of coolant in close contact with a large amount of air so that heat may be transferred from the coolant to the air
 - _____ k. Funnel-like structure attached to the radiator and extending around and behind the fan; used to make the fan more effective in pulling air through the radiator
 - _____ l. Cap used to regulate temperature adjustment on thermostat
 - _____ m. Hose used to connect the radiator to the engine
3. Explain the difference between the bellows type and the pellet type of thermostats.
4. Describe the operation of the thermostat during each of the following conditions.
- a. Engine is cold
 - b. Engine is at operating temperature

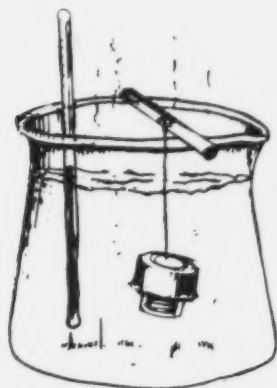
5. List three jobs performed by the cooling system.
- a.
 - b.
 - c.
6. Describe the differences between downflow and crossflow radiators.
7. Describe the following methods of cooling the internal combustion engine.
- a. Liquid
 - b. Air
8. Identify the following types of radiator hoses



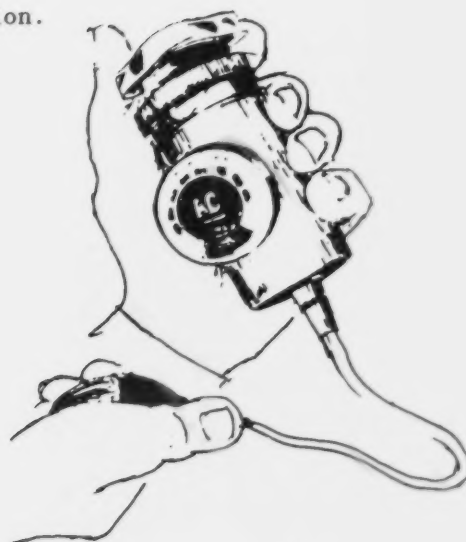
- a. _____
- b. _____
- c. _____

9. Describe the pressure cap operation during each of the following temperatures.
 - a. Cooling system at normal temperature
 - b. Cooling system very hot with built-up excess pressure
 - c. Cooling system during cooling-off period
10. Describe the operation of the variable-speed fan drive.
11. List three reasons for using a permanent antifreeze solution in the cooling system at all times.
 - a.
 - b.
 - c.
12. Describe the operation of a coolant recovery system.

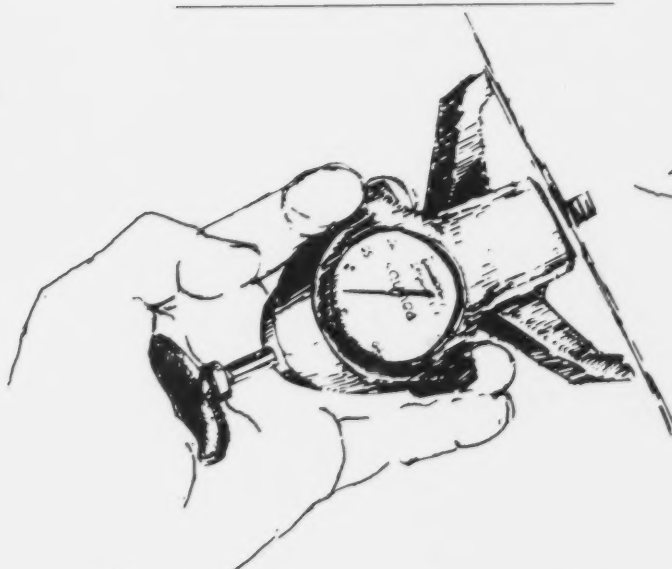
13. Describe what is being done in each illustration.



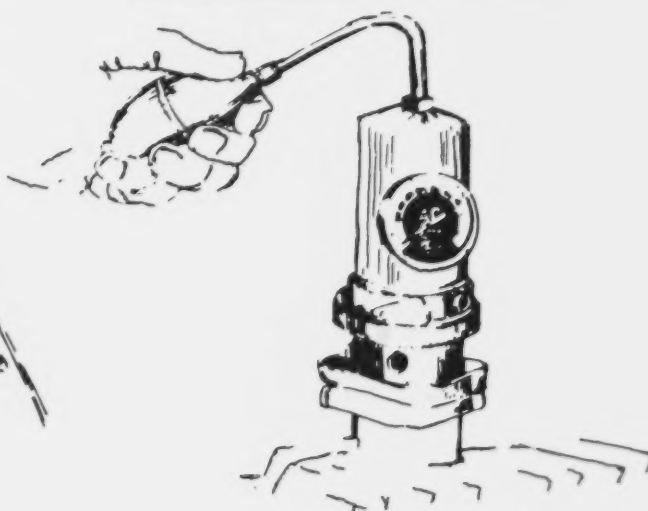
a. _____



b. _____



c. _____



d. _____

14. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I
____ II
____ III
____ IV
____ V
____ VI

____ VII
____ VIII
____ IX
____ X
____ XI

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

COOLING SYSTEM
UNIT II

LAP ASSIGNMENT SHEET #1--COOLING SYSTEM

NAME _____

SCORE _____

1. Describe the purpose of the cooling system by completing the following statement.

To keep the engine at its most efficient operating _____ during all engine _____ and driving _____.

2. Match the terms on the right to the correct definitions. Definitions continue on next page.

- | | |
|--|------------------|
| _____ a. Device generally mounted on the water pump hub assembly used to pull a large volume of air through the openings in the radiator core | 1. Water pump |
| _____ b. Heat-controlled valve in the cooling system used to regulate the flow of coolant between the cylinder block and radiator | 2. Water jacket |
| _____ c. Belt turned by a pulley on the front of the crankshaft used to drive the water pump, fan, and other engine accessories | 3. Radiator |
| _____ d. Centrifugal pump mounted at the front of the cylinder block to circulate the coolant throughout the cooling system | 4. Fan |
| _____ e. Passage through the block and cylinder head that allows the coolant to circulate around the cylinders, valves, and combustion chambers | 5. Shroud |
| _____ f. Cap which increases the pressure within the cooling system several pounds per square inch, allowing the coolant to circulate at higher temperatures without evaporation or surge loss | 6. Thermostat |
| _____ g. Device for holding a considerable volume of coolant in close contact with a large amount of air so that heat may be transferred from the coolant to the air | 7. Pressure cap |
| | 8. Radiator hose |
| | 9. V-belt |

- _____ h. Funnel-like structure attached to the radiator and extending around and behind the fan; used to make the fan more effective in pulling air through the radiator
 - _____ i. Hose used to connect the radiator to the engine
3. Distinguish between the two types of thermostats by placing a "B" in front of the statement describing a bellows type and a "P" in front of the pellet type.
- _____ a. Contains a special liquid which heat causes to expand and open the thermostat valve.
 - _____ b. Contains copper-impregnated wax which heat causes to expand and open the thermostat valve.
4. Describe the engine temperature which would normally lead to each of the following thermostat positions.
- a. Thermostat is open and allows coolant to circulate through the system.

 - b. Thermostat shuts off flow of coolant from the engine to the radiator to allow quicker engine warm-up.

5. Each of the following statements about jobs performed by the cooling system has some incorrect words in it. Cross out the incorrect words and write proper replacements in the blanks provided.
- a. Remove syrup or unwanted meat.

 - b. Maintain an efficient temper under all opposite conditions.

 - c. Bring an egg up to operating temperature as soon after stalling as possible.

6. Distinguish between downflow and crossflow radiators by telling which type is described by the two sets of statements below.
- a. _____
 - 1. Tanks on right and left sides.
 - 2. Flow of coolant from side to side across radiator.

b. _____

1. Tanks on top and bottom.
2. Flow of coolant from top to bottom.

7. Each of the following statements about methods of cooling the internal combustion engine has some scrambled words in it. Unscramble the words to make sense out of the statements.

a. Diquil -- Uses tricuglaint toolcan for engine heat removal

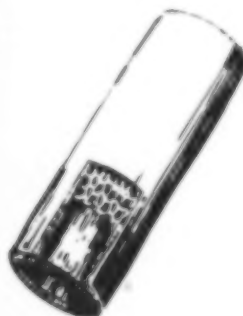
b. Ira -- Uses a naf, cooling snif, and engine drughsion for heat removal

8 Identify the following types of radiator hose by drawing a line from each illustration to its correct name.

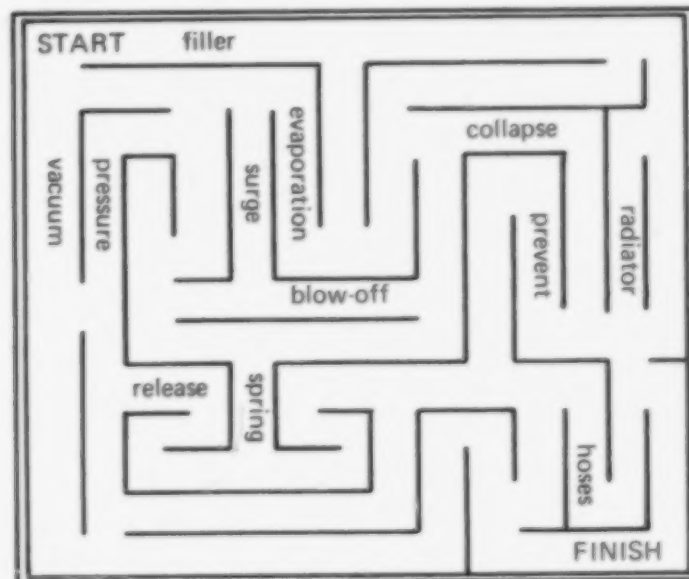
Accordian

Common

Molded or shaped

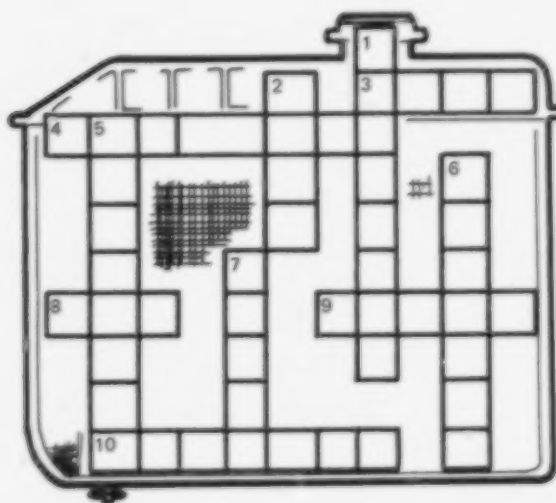


9. Describe pressure cap operation at various temperatures. Pressure caps regulate pressure in the cooling system by routing pressure along various paths. You can figure out the correct path through this maze by filling in the missing words in the statements below. By selecting the words in the maze in the proper sequence you can work your way through the maze without retracing any paths.



- Cooling system at normal temperature -- The pressure cap fits over the radiator tube and seals tightly around the edges to prevent _____ or _____ loss
 - Cooling system very hot with built-up excess pressure -- _____ valve has calibrated _____ which opens to _____ excess in cooling system
 - Cooling system during cooling-off period -- _____ valve opens to allow _____ to enter the cooling system to _____ of the _____ and _____
10. Describe how fan speed relates to engine temperature in variable-speed fan drive operation.

11. Give reasons for using permanent antifreeze solution by completing the following statements.
- Prevents coolant from _____
 - Has a _____ boiling point than water
 - Reduces the _____ action of water
12. Describe the operation by completing the crossword puzzle below.



- As the cooling system heats up and expands, the excess (6 Down) is forced through the (4 Across) valve in the radiator (8 Across) through the radiator (1 Down) tube into the coolant (10 Across) tank
 - As the engine (9 Across), the necessary amount of coolant is pulled back into the (5 Down) through the (3 Across) (7 Down) in the radiator cap, thus keeping the radiator (2 Down) at all times
13. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I
____ II
____ III
____ IV
____ V
____ VI

____ VII
____ VIII
____ IX
____ X
____ XI
____ XII

If any of the above areas is checked, study the required sections and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

COOLING SYSTEM
UNIT II

LAP ASSIGNMENT SHEET #2--COOLING SYSTEM

NAME _____ SCORE _____

1. Write the purpose of the cooling system.

2. Define the following terms.

- a. Fan -- _____

- b. Pressure Cap -- _____

- c. Radiator -- _____

- d. Radiator hose -- _____

- e. Shroud -- _____

- f. Thermostat -- _____

- g. V-belt -- _____

- h. Water jacket -- _____

- i. Water pump -- _____

3. Describe the differences between bellows type and pellet type of thermostats.
4. Describe the operation of the thermostat at various engine temperatures.
5. List three jobs that the cooling system must perform.
 - a.
 - b.
 - c.
6. Describe the differences between downflow and crossflow radiators.

7. Name and describe two methods of cooling the internal combustion engine.

8. Identify the following types of radiator hose.



a. _____



b. _____



c. _____

9. Describe pressure cap operation at various engine temperatures.

10. Describe the operation of the variable-speed fan drive.

11. List three reasons for using a permanent antifreeze solution in the cooling system at all times.

- a.
- b.
- c.

12. Describe the operation of a coolant recovery system.

13. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

ENGINE

INSTRUCTIONAL UNIT

ENGINE LUBRICATION SYSTEM
SECTION C--UNIT III

LEARNING ACTIVITY PACKET NO.

13

PREREQUISITE LAP(S)

1, 2, 11

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Engine Lubrication System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify engine lubrication system components and engine oils and describe their functions and applications. Additionally, the student will learn to change engine oil and oil filters.

TASKS INCLUDED IN THIS LAP:

1. Change oil in an engine.
2. Change an oil filter.

AUTO MECHANICS I
ENGINE LUBRICATION SYSTEM
SECTION C--UNIT III

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 119-C.
- ____ 2. Complete Engine Lubrication System Pre-Test, LAP page 5.
- ____ 3. Study The sections of the Information Sheet, pages 123-C through 126-C, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 11.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 17.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

Skilled

Moderately
Skilled

____ a. Change oil in an engine (9).

____ b. Change an oil filter (15).

- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If both tasks have been initialed, proceed to Step 21. Otherwise, continue to Step 8.

- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- ____ 9. Study Job Sheet #1--Change Oil in an Engine, page 133-C.
- ____ 10. Watch Slide/tape presentation "Change Oil in an Engine" (C-III-1).
- ____ 11. Do Job Sheet #1--Change Oil in an Engine.
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.
- ____ 15. Study Job Sheet #2--Change an Oil Filter, page 135-C.
- ____ 16. Watch Slide/tape presentation "Change an Oil Filter" (C-III-2).
- ____ 17. Do Job Sheet #2--Change an Oil Filter.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.

- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6f. If both tasks have been initialed, continue to Step 21. Otherwise, refer to the step number in parentheses after the unsigned task.
- ____ 21. Review Information Sheet (page 123-C).
- ____ 22. Take Engine Lubrication System Unit III Test (see your instructor). If you score 85 percent or more, continue to the next assigned Learning Activity Packet. If additional study is required, discuss study requirements and possible re-testing with your instructor.

ENGINE LUBRICATION SYSTEM
UNIT III

PRE-TEST

NAME _____ SCORE _____

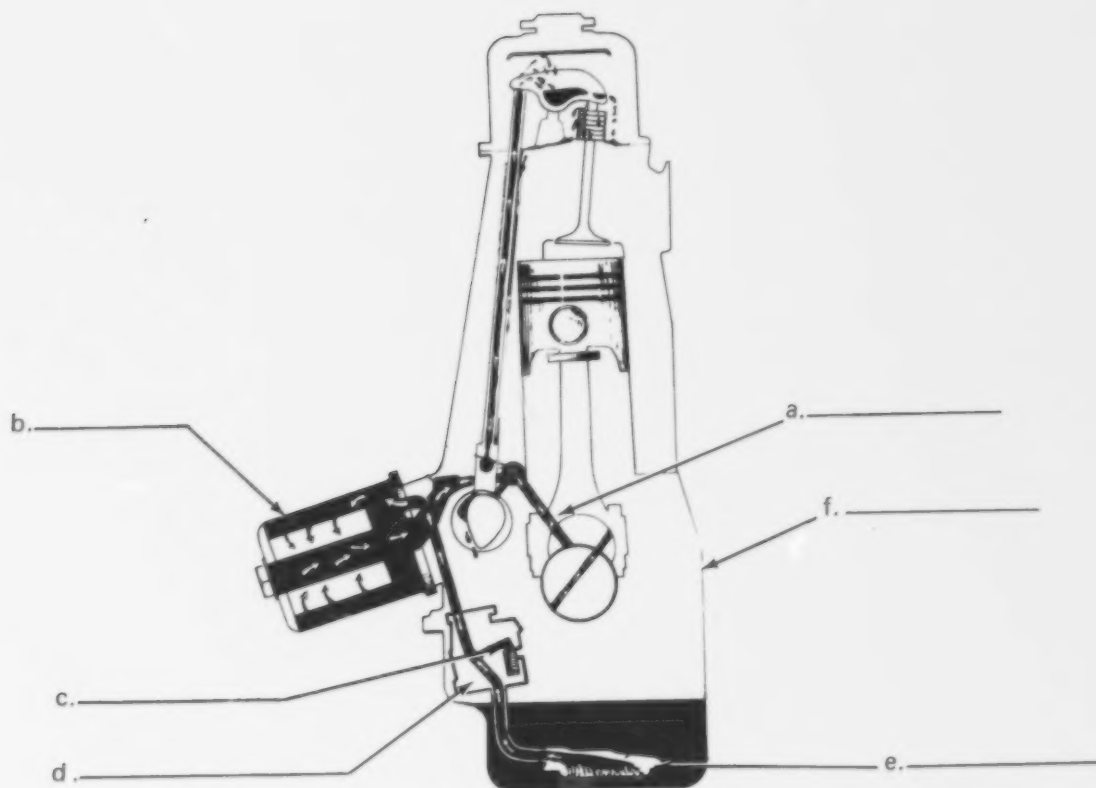
DIRECTIONS: This test is to determine how much you already know about the engine lubrication system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. Match the terms on the right to the correct definitions.

- | | | |
|----------|---|-------------------------|
| _____ a. | Engine sequence tests adopted by the American Society for Testing Materials | 1. Friction |
| _____ b. | Oil that meets the low temperature requirements of a light oil and the high temperature requirements of a heavy oil | 2. API |
| _____ c. | Automobile Petroleum Industry | 3. Viscosity index (VI) |
| _____ d. | Resistance to movement between any two objects placed in contact with each other | 4. SAE |
| _____ e. | American Society of Transportation Mechanics | 5. Viscosity |
| _____ f. | Specifications prepared by the Ordnance Department of the U.S. Army, Navy, and Air Force | 6. MIL |
| _____ g. | Measure of the ability of an oil to resist changes in viscosity when heated | 7. ASTM |
| _____ h. | Service classifications established by the American Petroleum Institute | 8. Multi-viscosity |
| _____ i. | Multi-Index Lubrication | |
| _____ j. | Measure of the ability of an oil to resist flowing | |
| _____ k. | Abbreviation for petroleum products certified for use in vehicles; safe for automobile engines | |

2. Discuss the purposes of the lubrication system.

3. Identify each component of the engine lubrication system shown in the diagram below.



4. Describe the purpose of the lubrication system components illustrated in item 3 above.

a. _____

b. _____

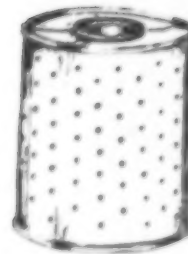
c. _____

d. _____

- e. _____

f. _____

5. Identify the following oil filters.



- a. _____ b. _____

6. Name the two methods of classifying engine oil.

a.

b.

7. Discuss oil viscosity classifications.

8. Match the letter designations on the right to the correct descriptions.

- | | | |
|----------|---|-------|
| _____ a. | Oil which meets the 1972 requirements of the automobile manufacturers and provides high temperature anti-oxidation, low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars | 1. SA |
| _____ b. | Oil without additive except that it may contain pour and/or foam depressants; utility engine service | 2. SB |
| _____ c. | Oil which provides some anti-oxidant and anti-scuff capabilities; minimum duty gasoline engine service | 3. SC |
| _____ d. | Oil which meets the 1964-1967 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars | 4. SD |
| _____ e. | Oil which meets the 1968-1971 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars | 5. SE |

9. List points to consider when selecting engine oil.

- a.
- b.
- c.
- d.

10. List eight additives found in engine oil.

- a.
- b.
- c.
- d.
- e.

f.

g.

h.

11. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

____ I

____ VI

____ II

____ VII

____ III

____ VIII

____ IV

____ IX

____ V

____ X

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

ENGINE LUBRICATION SYSTEM
UNIT III

LAP ASSIGNMENT SHEET #1--LUBRICATION

NAME _____ SCORE _____

1. Match the terms on the right to the correct definitions.

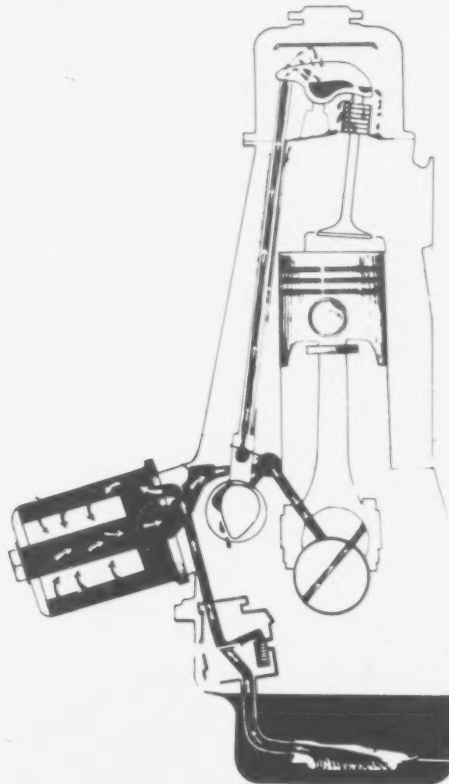
- | | | |
|----------|---|-------------------------|
| _____ a. | Engine sequence tests adopted by the American Society for Testing Materials | 1. Friction |
| _____ b. | Oil that meets the low temperature requirements of a light oil and the high temperature requirements of a heavy oil | 2. API |
| _____ c. | Resistance to movement between any two objects placed in contact with each other | 3. Viscosity index (VI) |
| _____ d. | Specifications prepared by the Ordnance Department of the U.S. Army, Navy, and Air Force | 4. SAE |
| _____ e. | Measure of the ability of an oil to resist changes in viscosity when heated | 5. Viscosity |
| _____ f. | Service classifications established by the American Petroleum Institute | 6. MIL |
| _____ g. | Measure of the ability of an oil to resist flowing | 7. ASTM |
| _____ h. | Viscosity ratings established by the Society of Automotive Engineers | 8. Multi-viscosity |

2. List purposes of the engine lubrication system by completing the statements below. The answers can be found in the following word search. Words are hidden vertically, horizontally, and diagonally, both forward and backward.

FTWALLSC
GRGNIVOM
SIINSOFA
MNPCLAN
EGDITOL
OSNQAIL
KGBHEUOC
RKCOHSJN
BEARINGS

- Lubricates parts to minimize _____.
 - Acts as a _____ agent to remove _____ from engine parts.
 - Forms a _____ between piston _____ and cylinder _____.
 - Keeps parts _____.
 - Absorbs _____ between _____ and other parts.
3. Identify the components of the engine lubrication system by drawing a line from each term in its correct location.

Oil pressure relief valve
Oil pickup
Oil pump
Oil galleries
Oil pan
Oil filter



4. Describe the functions of the components of the lubrication system by unscrambling the component names below.

- a. Oil R E G A L L Y -- Pipe or passageway in the engine used to carry engine oil from one area to another.

- b. Oil L I F T E R -- Device used to strain the engine oil thus removing abrasive particles.

- c. Oil S U P E R S E R R E F I L E L A V V E -- Valve in the lubrication system designed to limit maximum oil pressure.

- d. Oil M U P P -- Device used to force oil under pressure to various parts of the engine for lubrication.

- e. Oil C U P K I P -- Device which allows the pump to pick up oil from the oil pan.

- f. Oil N A P -- Cover on the bottom of the engine which provides a reservoir for the engine oil.

5. Identify the following types of filters by writing the correct name under each type.

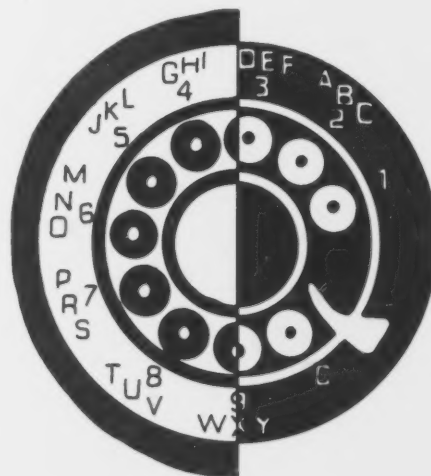
Sealed cartridge
Replaceable element



a. _____

b. _____

6. Name two methods of classifying engine oil by solving the following codes. The names have been encoded using the telephone dial with each number representing the letters which go with that number on the phone.



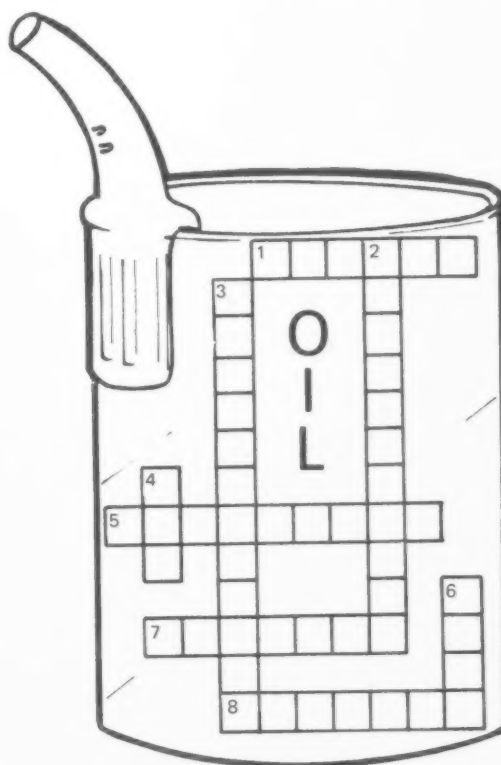
- a. 3-4-8-2-7-8-4-9-0 rating

- b. 7-3-7-8-4-2-3 or 7-3-7-3-6-7-6-2-6-2-3

7. Discuss oil viscosity classifications by completing the following statements.
- a. _____ grade
1. Each grade is compounded for a specific _____ range.
 2. The larger the number, the _____ the oil.
- b. Multi-grade -- Designed for use over a _____ temperature range.
8. Match the letter designations on the right to the correct descriptions.

- | | |
|--|-------|
| _____ a. Oil which meets the 1972 requirements of the automobile manufacturers and provides high temperature anti-oxidation, low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars | 1. SA |
| _____ b. Oil without additive except that it may contain pour and/or foam depressants; utility engine service | 2. SB |
| _____ c. Oil which provides some anti-oxidant and anti-scuff capabilities; minimum duty gasoline engine service | 3. SC |
| | 4. SD |
| | 5. SE |

- _____ d. Oil which meets the 1964-1967 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars
- _____ e. Oil which meets the 1968-1971 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars
9. List points to consider when selecting engine oil by completing the crossword puzzle below.



- a. Use oil of the proper (5 Across) for the average (2 Down) in which the vehicle will operate.
- b. Use oil of the proper (7 Across) rating as recommended by the (3 Down).
- c. Select (6 Down) which have been performance (1 Across).
- d. Do not (4 Down) oils of various service or viscosity (8 Across).

10. Name additives found in engine oil by placing an "X" beside each correct additive.

- ☐ a. Congealing inhibitor
- ☐ b. Anti-corrosion additives
- ☐ c. Anti-rust additives
- ☐ d. Thinner
- ☐ e. Oxidation inhibitor
- ☐ f. Wax solvent
- ☐ g. Viscosity index improver
- ☐ h. Flow inhibitor
- ☐ i. Pour point depressant
- ☐ j. Extreme pressure additive
- ☐ k. Viscosity multiplier solution
- ☐ l. Detergent dispersant
- ☐ m. Foam inhibitor

11. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

- | | |
|------------------------------|-------------------------------|
| ☐ I | ☐ VI |
| ☐ II | ☐ VII |
| ☐ III | ☐ VIII |
| ☐ IV | ☐ IX |
| ☐ V | ☐ X |

If any of the above areas is checked, study the required sections and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

ENGINE LUBRICATION SYSTEM
UNIT III

LAP ASSIGNMENT SHEET #2--LUBRICATION

NAME _____ SCORE _____

1. Define the following terms.

- a. API -- _____

- b. ASTM -- _____

- c. Friction -- _____

- d. MIL -- _____

- e. Multi-viscosity -- _____

- f. SAE -- _____

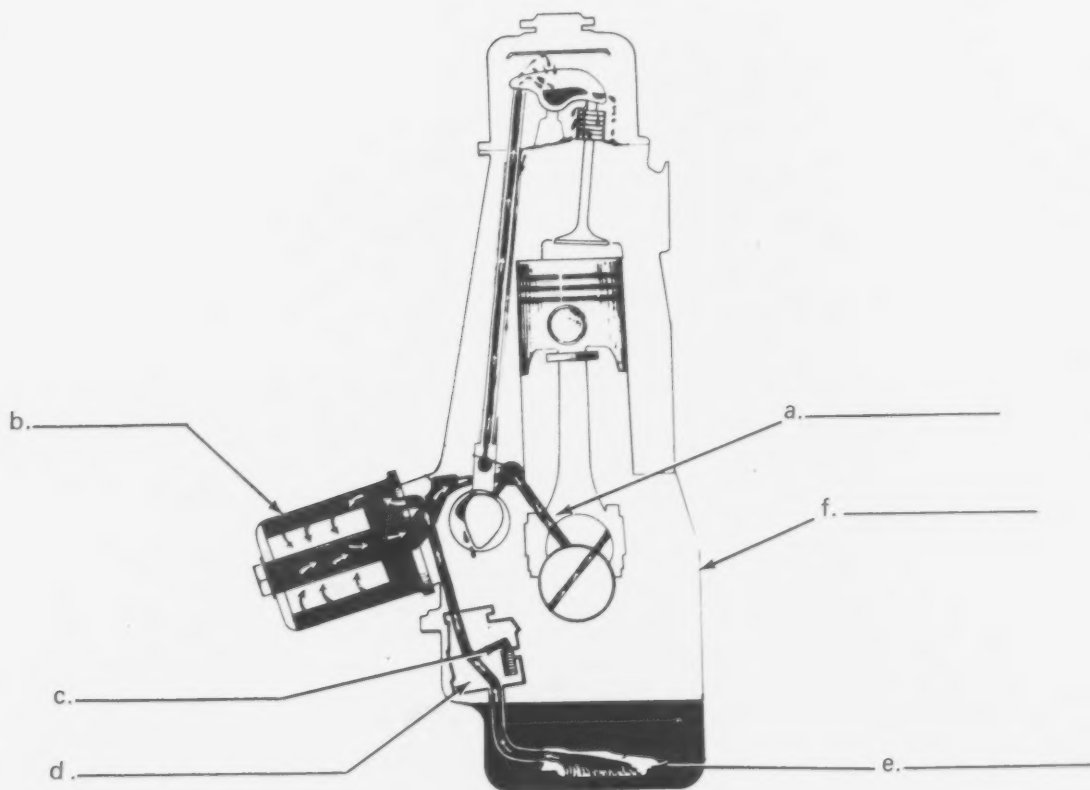
- g. Viscosity -- _____

- h. Viscosity index (VI) -- _____

2. List the purposes of the engine lubrication system.

- a.
- b.
- c.
- d.
- e.

3. Identify the components of the engine lubrication system in the illustration below.



4. Describe the purpose of each component of the engine lubrication system given in your answer to item 3.

a. _____

b. _____

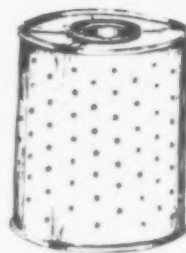
c. _____

d. _____

- e. _____

f. _____

5. Identify the following oil filters.



- a. _____ b. _____
6. Name two methods of classifying engine oil.
- a. _____
- b. _____
7. Discuss oil viscosity classifications.

8. Write the oil letter designation which goes with each of the following descriptions.

- _____ a. Oil which meets the 1972 requirements of the automobile manufacturers and provides high temperature anti-oxidation, low temperature anti-oxidation, low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars.

- ☐ b. Oil without additive except that it may contain pour and/or foam depressants; utility engine service.
 - ☐ c. Oil which provides some anti-oxidant and anti-scuff capabilities; minimum duty gasoline engine service.
 - ☐ d. Oil which meets the 1964-1967 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars.
 - ☐ e. Oil which meets the 1968-1971 requirements of the automobile manufacturers and provides low temperature anti-sludge and anti-rust performance; intended primarily for use in passenger cars.
- 9. List points to consider when selecting engine oil.
 - a.
 - b.
 - c.
 - d.
- 10. List eight additives found in engine oil.
 - a.
 - b.
 - c.
 - d.
 - e.
 - f.
 - g.
 - h.
- 11. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

ENGINE

INSTRUCTIONAL UNITEXHAUST SYSTEM
SECTION C--UNIT IV**LEARNING ACTIVITY PACKET NO.****14****PREREQUISITE LAP(S)**

1, 2, 11

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Exhaust System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to describe the construction and operation of a conventional exhaust system and a system with a catalytic converter and to service or replace exhaust system components.

TASKS INCLUDED IN THIS LAP:

1. Service a manifold heat control valve.
2. Remove and replace an exhaust manifold.
3. Remove and replace an exhaust pipe.
4. Remove and replace a muffler.
5. Remove and replace a catalytic converter and its heat shields.
6. Remove and replace a tail pipe.

AUTO MECHANICS I
EXHAUST SYSTEM
SECTION C--UNIT IV

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 149-C.
- ____ 2. Complete Exhaust System Pre-Test, LAP page 7.
- ____ 3. Study The Sections of the Information Sheet, pages 153-C through 156-C, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 13.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 21.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Service a manifold heat control valve (9).	_____	_____
____ b.	Remove and replace an exhaust manifold (15).	_____	_____
____ c.	Remove and replace an exhaust pipe (21).	_____	_____

- ____ d. Remove and replace a muffler (27). _____
- ____ e. Remove and replace a catalytic converter and its heat shields (33). _____
- ____ f. Remove and replace a tail pipe (39). _____
-
- ____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 45. Otherwise, continue to Step 8.
-
- ____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
-
- ____ 9. Study Job Sheet #1--Service a Manifold Heat Control Valve, page 171-C.
-
- ____ 10. Watch Slide/tape presentation "Service a Manifold Heat Control Valve" (C-IV-1).
-
- ____ 11. Do Job Sheet #1--Service a Manifold Heat Control Valve
-
- ____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
-
- ____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.

- ____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise continue to Step 15.
- ____ 15. Study Job Sheet #2--Remove and Replace an Exhaust Manifold, page 173-C.
- ____ 16. Watch Slide/tape presentation "Remove and Replace an Exhaust Manifold" (C-IV-2).
- ____ 17. Do Job Sheet #2--Remove and Replace an Exhaust Manifold.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Remove and Replace an Exhaust Pipe, page 175-C.
- ____ 22. Watch Slide/tape presentation "Remove and Replace an Exhaust Pipe" (C-IV-3).
- ____ 23. Do Job Sheet #3--Remove and Replace an Exhaust Pipe.

- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.
- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6d. If this task has been initialed, proceed to Step 32. Otherwise, continue to Step 27.
- ____ 27. Study Job Sheet #4--Remove and Replace a Muffler, page 179-C.
- ____ 28. Watch Slide/tape presentation "Remove and Replace a Muffler" (C-IV-4).
- ____ 29. Do Job Sheet #4--Remove and Replace a Muffler.
- ____ 30. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and proceed to Step 32. Otherwise, repeat Steps 27-29 and then go to Step 31.
- ____ 31. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and continue to Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6d and continue to Step 32.
- ____ 32. Refer To Step 6e. If this task has been initialed, proceed to Step 38. Otherwise, continue to Step 33.

- ____ 33. Study Job Sheet #5--Remove and Replace a Catalytic Converter, page 183-C.
- ____ 34. Watch Slide/tape presentation, "Remove and Replace a Catalytic Converter" (C-IV-5).
- ____ 35. Do Job Sheet #5--Remove and Replace a Catalytic Converter.
- ____ 36. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and proceed to Step 38. Otherwise, repeat Steps 33-35 and then go to Step 37.
- ____ 37. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and continue to Step 38. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6e and continue to Step 38.
- ____ 38. Refer To Step 6f. If this task has been initialed, proceed to Step 44. Otherwise, continue to Step 39.
- ____ 39. Study Job Sheet #6--Remove and Replace a Tail Pipe, page 185-C.
- ____ 40. Watch Slide/tape presentation "Remove and Replace a Tail Pipe (C-IV-6).
- ____ 41. Do Job Sheet #6--Remove and Replace a Tail Pipe.
- ____ 42. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6f and proceed to Step 44. Otherwise, repeat Steps 39-41 and then go to Step 43.

- ____ 43. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6f and continue to Step 44. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6 and continue to Step 44.
- ____ 44. Refer To Step 6. If all tasks have been initialed, continue to Step 45. Otherwise, refer to the step number in parentheses after the unsigned task.
- ____ 45. Review Information Sheet (page 153-C).
- ____ 46. Take Exhaust System Unit IV Test (see your instructor). If you score 85 percent or more, continue to the next assigned Learning Activity Packet. If additional study is required, discuss study requirements and possible re-testing with your instructor.

EXHAUST SYSTEM
UNIT IV

PRE-TEST

NAME _____ SCORE _____

DIRECTIONS: This test is to determine how much you already know about the exhaust system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

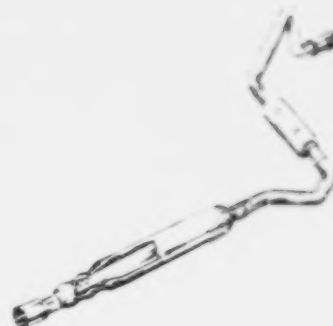
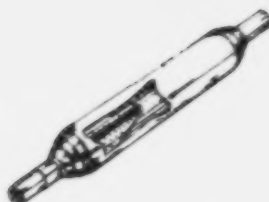
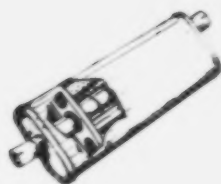
1. Write the two purposes of the exhaust system.
 - a.
 - b.

2. Match the terms on the right to their correct definitions. Definitions continue on the next page.

_____ a. Device to recirculate exhaust gases through the catalytic converter.	1. Exhaust manifold
_____ b. Circular bolt used to clamp the exhaust pipe and tail pipe to the muffler	2. Exhaust pipe
_____ c. Pipe connecting the engine exhaust ports to the exhaust pipe; usually made of cast iron	3. Muffler
_____ d. Pipe connecting the exhaust manifold to the resonator	4. Tail pipe
_____ e. Valve located in the exhaust manifold that deflects a certain amount of hot gas around the carburetor base to aid engine warm-up	5. Pipe clamp
_____ f. Metal and fabric strip used to support the exhaust system on the vehicle	6. Pipe hanger
_____ g. Material whose presence alters the rate of a chemical reaction of the exhaust gases producing a combustion-like reaction	7. Manifold heat control valve
_____ h. Chamber used to burn the catalysts found in exhaust gases	8. Resonator
	9. Crossover pipe
	10. Catalyst
	11. Catalytic converter

- ____ i. Device in an automobile exhaust system which contains a catalyst and burns exhaust gases into harmless materials
- ____ j. Pipe used on V-type engines to connect exhaust manifolds together to enter a single exhaust pipe
- ____ k. Toxic pollutants produced by the combustion process in automobile engines; a major part of engine exhaust
- ____ l. Any of several devices used to secure the manifold, exhaust pipe, muffler, catalytic converter, and tail pipe
- ____ m. Chamber through which the exhaust gases are passed to quiet the sounds of the running engine
- ____ n. Pipe connecting the exhaust manifold to the muffler
- ____ o. Valve located in the exhaust manifold that circulates cooling air to cool the exhaust in the manifold
- ____ p. Small muffler like device placed near the end of the tail pipe to provide additional silencing of the exhaust
- ____ q. Exhaust pipe running from the muffler to the rear of the car

3. Identify the following types of mufflers.

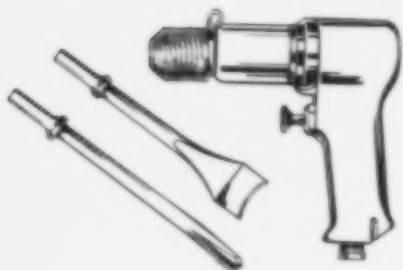


a. _____ b. _____ c. _____

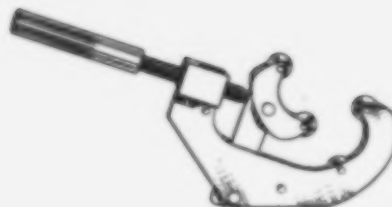
4. Describe the operation of the manifold heat control valve with the engine at different temperatures.

5. Describe the construction and operation of a catalytic converter.

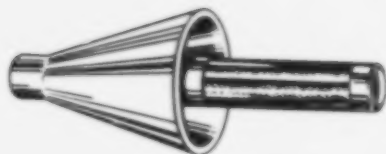
6. Identify the following tools used for exhaust system service.



a. _____



b. _____



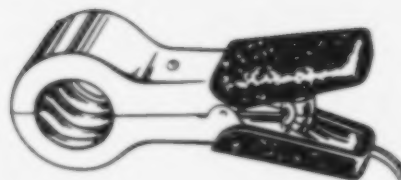
c. _____



d. _____



e. _____



f. _____

7. Describe the differences between single and dual type exhaust systems.
8. List two safety precautions for preventing carbon monoxide poisoning.
 - a.
 - b.
9. Discuss the causes of internal and external corrosion of the exhaust system.

10. Identify the basic components of the exhaust gas recirculation system in the drawing below.



11. Discuss the purpose of the exhaust gas recirculating system.
12. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

___ I	___ VII
___ II	___ VIII
___ III	___ IX
___ IV	___ X
___ V	___ XI
___ VI	

You came here from LAP Step 2. If any of the above areas is checked, continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

EXHAUST SYSTEM
UNIT IV

LAP ASSIGNMENT SHEET #1--EXHAUST SYSTEM

NAME _____ SCORE _____

1. Write the purposes of the exhaust system by completing the following statements.

- a. Conduct the burned _____ from the engine away from the passenger compartment.
- b. _____ the _____ of the exhaust.

2. Match the terms on the right to the correct definitions. Definitions continue on the next page.

- | | | | |
|----------|--|-----|-----------------------------|
| _____ a. | Circular bolt used to clamp the exhaust pipe and tail pipe to the muffler | 1. | Exhaust manifold |
| _____ b. | Pipe connecting the engine exhaust ports to the exhaust pipe; usually made of cast iron | 2. | Exhaust pipe |
| _____ c. | Valve located in the exhaust manifold that deflects a certain amount of hot gas around the carburetor base to aid engine warm-up | 3. | Muffler |
| _____ d. | Metal and fabric strap used to support the exhaust system on the vehicle | 4. | Tail pipe |
| _____ e. | Material whose presence alters the rate of a chemical reaction to the exhaust gases producing a combustion-like reaction | 5. | Pipe clamp |
| _____ f. | Chamber through which the exhaust gases are passed to quiet the sounds of the running engine | 6. | Pipe hanger |
| _____ g. | Pipe connecting the exhaust manifold to the muffler | 7. | Manifold heat control valve |
| _____ h. | Device in automobile exhaust system which contains a catalyst and burns exhaust gases into harmless materials | 8. | Resonator |
| | | 9. | Crossover pipe |
| | | 10. | Catalyst |
| | | 11. | Catalytic converter |

- ____ i. Pipe used on V-type engines to connect exhaust manifolds together to enter a single exhaust pipe
- ____ j. Small muffler like device placed near the end of the tail pipe to provide additional silencing of the exhaust
- ____ k. Exhaust pipe running from the muffler to the rear of the car

3. Identify the following types of mufflers by selecting the correct name.

Reverse flow

Chambered pipe

Straight through



- a. _____ b. _____ c. _____

4. Describe the operation of the manifold heat control valve. The answers to two questions about the operation of the manifold heat control valve and engine temperature are given below. Write the correct question for each answer in the space provided.

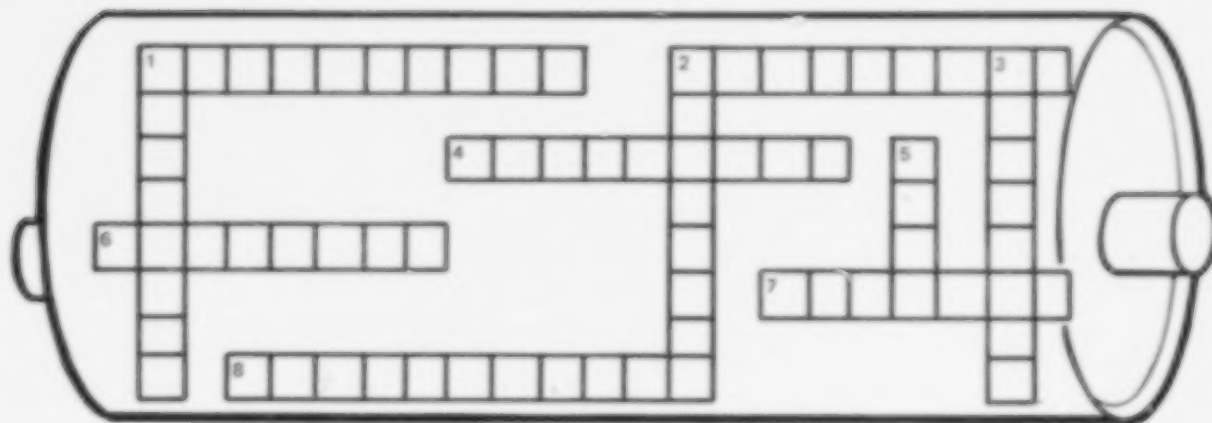
a. Question: _____

Answer: Heat control valve is shut to allow exhaust gases to pass under the carburetor base to bring about better fuel atomization and warm-up

b. Question: _____

Answer: Heat control valve is open to allow exhaust gases to pass out the exhaust system

5. Describe the construction and operation of catalytic converter by completing the crossword puzzle below.



- a. Is constructed of (4 Across) steel shell.
- b. Contains (8 Across) or (2 Down) element coated with (6 Across) and (2 Across).
- c. Operates by (1 Across) reaction of a (1 Down) producing heat up to 1600 degrees under normal conditions.
- d. Uses heat (7 Across) to protect underside of car from excessive heat.
- e. Requires use of (3 Down) gasoline as fuel.
- f. Contains access (5 Down) for exhaust sampling usually.

6. Identify the following exhaust system service tools by selecting the correct name.

Hand pipe cutter
Pipe extending tool
Chain wrench

Power chisel
Electric pipe joint heater
Straightening cone



a. _____



b. _____



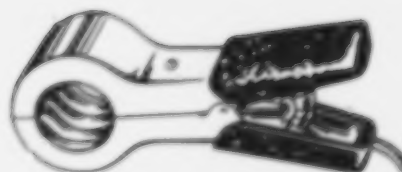
c. _____



d. _____



e. _____



f. _____

7. Distinguish between the types of exhaust systems by placing an "S" in front of the description of a single type and a "D" in front of the dual type exhaust system.

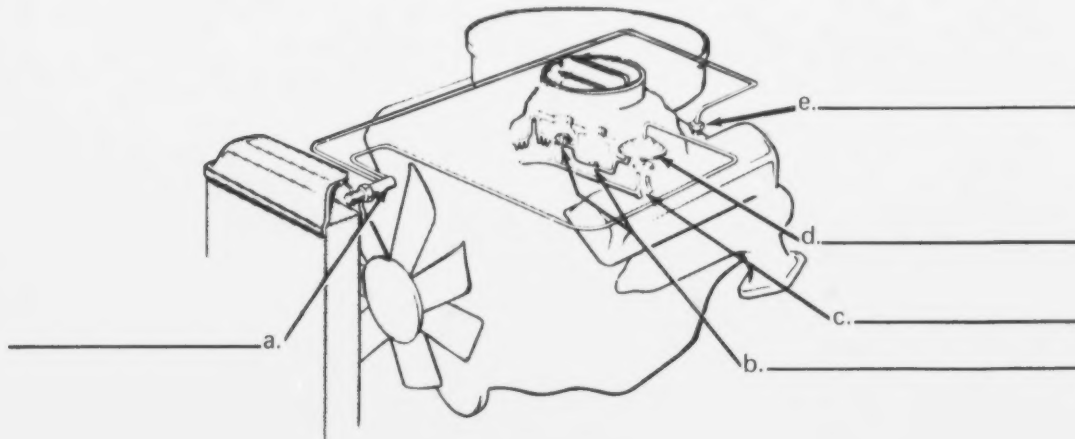
_____ a. Uses one exhaust pipe, muffler and tail pipe; requires use of a crossover pipe.

- _____ b. Uses two separate exhaust pipes, mufflers, and tail pipes; does not require use of a crossover pipe.
8. List two safety precautions for preventing carbon monoxide poisoning by placing an "X" beside each correct statement.
- _____ a. Drive with the windows down when exhaust system leaks are present.
- _____ b. Do not operate engines in a closed shop without adequate ventilation.
- _____ c. Repair leaks in an exhaust system immediately to prevent asphyxiation of the driver and passengers.
- _____ d. Never operate engines in the shop.
9. Discuss the causes of corrosion of the exhaust system by correcting each of the following statements. Each statement has one or more incorrect words in it. Cross out the incorrect words and write the proper responses in the blanks provided.
- a. Internal corrosion
1. Water caused by the confusion process collects in the muffler
- _____
2. Water mixing with exhaust gasps create a light acne that etches the exhaust metal
- _____
3. Corrosion is extreme during shopping drives because the system does not get old enough to estimate the water
- _____
- b. External corrosion
1. Busting occurs due to pain, sneers, and humility
- _____
2. Corrosion is acceptable by the use of silt on icy road surfaces
- _____

10. Identify the components of the exhaust gas recirculating system by selecting the correct name.

Intake manifold ports
Coolant control valve
Vaccum source

EGR control valve
Exhaust transfer passage



11. Discuss the purpose of the exhaust gas recirculating system by rearranging the words below into the proper order.

Gases reduce peak exhaust oxides during flame combustion by lowering temperature of nitrogen (NOX) in to engine.

_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

12. Stop. Have your instructor evaluate your Assignment Sheet and mark the areas below which require additional study.

Refer to Information Sheet Sections:

____ I	____ VII
____ II	____ VIII
____ III	____ IX
____ IV	____ X
____ V	____ XI
____ VI	

If any of the above areas is checked, study the required sections of the Information Sheet and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

EXHAUST SYSTEM
UNIT IV

LAP ASSIGNMENT SHEET #2--EXHAUST SYSTEM

NAME _____ SCORE _____

1. Write the two purposes of the exhaust system.

a.

b.

2. Define the following terms.

a. Catalyst -- _____

b. Catalytic converter -- _____

c. Crossover pipe -- _____

d. Exhaust manifold -- _____

e. Exhaust pipe -- _____

f. Manifold heat control valve -- _____

g. Muffler -- _____

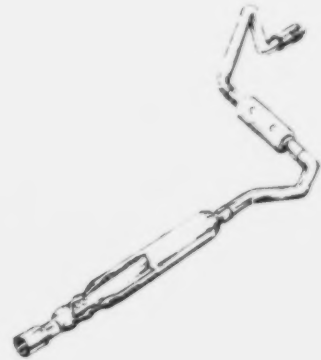
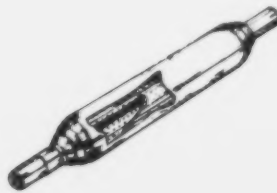
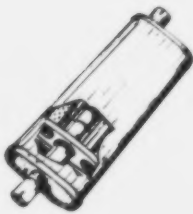
h. Pipe clamp -- _____

i. Pipe hanger -- _____

j. Resonator -- _____

k. Tail pipe -- _____

3. Identify the following types of mufflers.

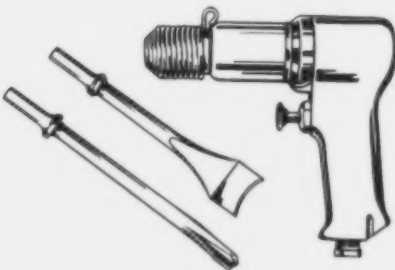


a. _____ b. _____ c. _____

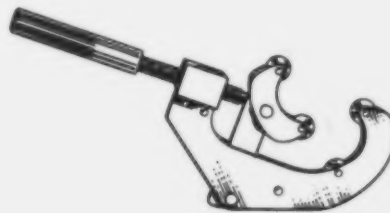
4. Describe the operation of the manifold heat control valve at different engine temperatures.

5. Describe the construction and operation of a catalytic converter.

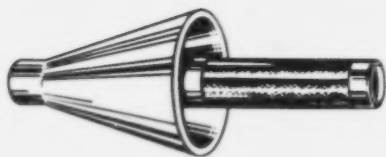
6. Identify the following tools used for exhaust system service.



a. _____



b. _____



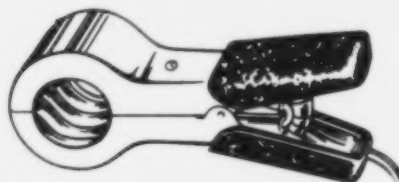
c. _____



d. _____



e. _____



f. _____

7. Describe the difference between dual and single type exhaust systems.

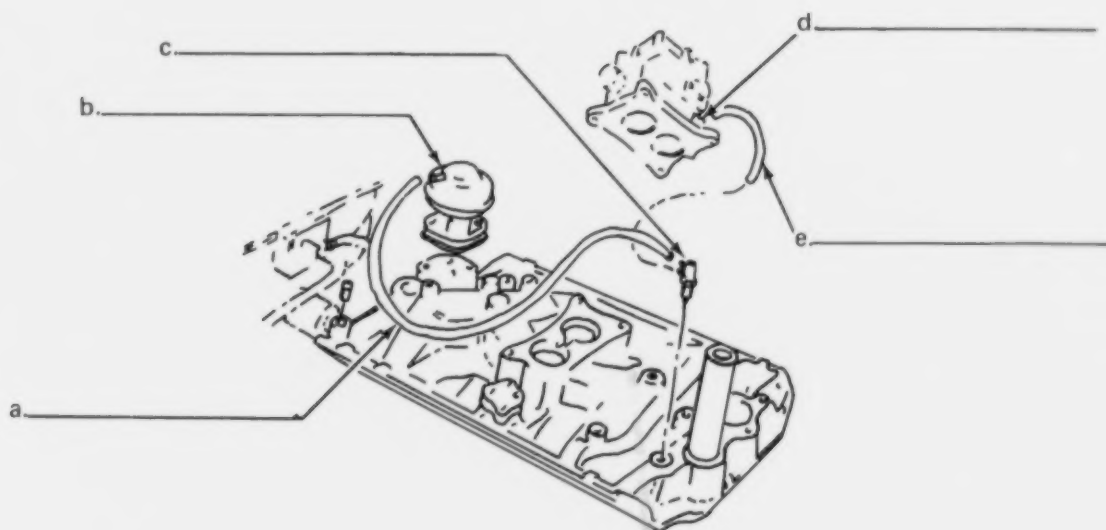
8. List two safety precautions for preventing carbon monoxide poisoning.

a. _____

b. _____

9. Discuss the causes of internal and external corrosion of the exhaust system.

10. Identify the basic components of the exhaust gas recirculation system in the diagram below.



11. Discuss the purpose of the exhaust gas recirculation system.
12. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue to LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.

**State Department
of
Vocational and Technical
Education
CIMC
Stillwater, Oklahoma
LEARNING ACTIVITY
PACKETS**

for AUTO MECHANICS I

MAJOR INSTRUCTIONAL AREA

ENGINE

INSTRUCTIONAL UNIT

FUEL SYSTEM
SECTION C--UNIT V

LEARNING ACTIVITY PACKET NO.

15

PREREQUISITE LAP(S)

1, 2, 11

PURPOSE: This Learning Activity Packet (LAP) outlines the study activities and performance tasks for "Fuel System." Accomplishing these procedures will aid the student in attaining a working knowledge of this area of training and in achieving a Skilled or Moderately Skilled competency level in the performance of jobs associated with this specialty.

INTRODUCTION: The course of study in this LAP will help the student become able to identify and write the purpose of the fuel system and perform service on the fuel system.

TASKS INCLUDED IN THIS LAP:

1. Volume and pressure test a fuel pump.
2. Remove and replace a fuel pump.
3. Service an air cleaner.
4. Remove and replace a carburetor.
5. Disassemble, adjust, and reassemble a carburetor.

AUTO MECHANICS I
FUEL SYSTEM
SECTION C--UNIT V

LEARNING STEPS

Check the Following
Blanks as You Complete
Each Required Step

- ____ 1. Read Unit and Specific Objectives, page 199-C.
- ____ 2. Complete Fuel System Pre-Test, LAP page 7.
- ____ 3. Study The Sections of the Information Sheet, pages 203-C through 206-C, indicated by your instructor on your Pre-Test. Be sure to study the transparency masters when required.
- ____ 4. Do LAP Assignment Sheet #1, LAP page 15.
- ____ 5. Do LAP Assignment Sheet #2, LAP page 21.
- ____ 6. Check The tasks below which you feel that you can do without supervision.

Student
Check

Instructor
Initials/Date

		Skilled	Moderately Skilled
____ a.	Volume and pressure test a fuel pump (9).	_____	_____
____ b.	Remove and replace a fuel pump (15).	_____	_____
____ c.	Service an air cleaner (21).	_____	_____
____ d.	Remove and replace a carburetor (27).	_____	_____

- _____ e. Disassemble, adjust, and reassemble a carburetor (33).
- _____ 7. Discuss Your competency in each task with your instructor. Your instructor will initial each task in which you demonstrate sufficient competency. If all tasks have been initialed, proceed to Step 38. Otherwise, continue to Step 8.
- _____ 8. Refer To Step 6a. If this task has been initialed, proceed to Step 14. Otherwise, continue to Step 9.
- _____ 9. Study Job Sheet #1--Volume and Pressure Test a Fuel Pump, page 237-C.
- _____ 10. Watch Slide/tape presentation "Volume and Pressure Test a Fuel Pump" (C-V-1).
- _____ 11. Do Job Sheet #1--Volume and Pressure Test a Fuel Pump.
- _____ 12. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and proceed to Step 14. Otherwise, repeat Steps 9-11 and then go to Step 13.
- _____ 13. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6a and continue to Step 14. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6a and continue to Step 14.
- _____ 14. Refer To Step 6b. If this task has been initialed, proceed to Step 20. Otherwise, continue to Step 15.

- ____ 15. Study Job Sheet #2--Remove and Replace a Fuel Pump, page 241-C.
- ____ 16. Watch Slide/tape presentation "Remove and Replace a Fuel Pump" (C-V-2).
- ____ 17. Do Job Sheet #2--Remove and Replace a Fuel Pump.
- ____ 18. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and proceed to Step 20. Otherwise, repeat Steps 15-17 and then go to Step 19.
- ____ 19. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6b and continue to Step 20. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6b and continue to Step 20.
- ____ 20. Refer To Step 6c. If this task has been initialed, proceed to Step 26. Otherwise, continue to Step 21.
- ____ 21. Study Job Sheet #3--Service an Air Cleaner, page 245-C.
- ____ 22. Watch Slide/tape presentation "Service an Air Cleaner" (C-V-3).
- ____ 23. Do Job Sheet #3--Service an Air Cleaner.
- ____ 24. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and proceed to Step 26. Otherwise, repeat Steps 21-23 and then go to Step 25.

- 4
- ____ 25. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6c and continue to Step 26. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6c and continue to Step 26.
- ____ 26. Refer To Step 6d. If this task has been initialed, proceed to Step 32. Otherwise, continue to Step 27.
- ____ 27. Study Job Sheet #4--Remove and Replace a Carburetor, page 251-C.
- ____ 28. Watch Slide/tape presentation "Remove and Replace a Carburetor" (C-V-4).
- ____ 29. Do Job Sheet #4--Remove and Replace a Carburetor.
- ____ 30. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and proceed to Step 32. Otherwise, repeat Steps 27-29 and then go to Step 31.
- ____ 31. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6d and continue to Step 32. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6d and continue to Step 32.
- ____ 32. Refer To Step 6e. If this task has been initialed, proceed to Step 38. Otherwise, continue to Step 33.
- ____ 33. Study Job Sheet #5--Disassemble, Adjust, and Reassemble a Carburetor, page 255-C.

- ____ 34. Watch Slide/tape presentation "Disassemble, Adjust, and Reassemble a Carburetor" (C-V-5).
- ____ 35. Do Job Sheet #5--Disassemble, Adjust, and Reassemble a Carburetor.
- ____ 36. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and proceed to Step 38. Otherwise, repeat Steps 33-35 and then go to Step 37.
- ____ 37. Stop. Have your instructor evaluate your work. If you achieve a SKILLED or MODERATELY SKILLED rating, have your instructor initial Step 6e and continue to Step 38. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, have your instructor initial Step 6e and continue to Step 38.
- ____ 38. Refer To Step 6. If all tasks have been initialed, continue to Step 39. Otherwise, refer to the step indicated in parentheses after the unsigned task.
- ____ 39. Review Information Sheet (page 203-C).
- ____ 40. Take Fuel System Unit V Test (see your instructor). If you achieve a score of 85 percent or more, continue to the next assigned Learning Activity Packet. Otherwise, discuss additional training requirements and possible re-testing with your instructor.

FUEL SYSTEM
UNIT V
PRE-TEST

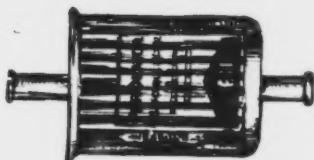
NAME _____

SCORE _____

DIRECTIONS: This test is to determine how much you already know about the fuel system. Your performance on this test will not be used to determine your grade in the course. Instead, it will guide your instructor in designing this course to meet your needs. Answer only those questions for which you are certain of the answer. Guessing may prevent you from receiving the lessons which are required.

1. Write the purpose of the fuel system.
2. Define the following terms.
 - a. Atomization--
 - b. Venturi--
 - c. Metering--
3. List one purpose for each of the following components of the fuel system.
 - a. Fuel tank--
 - b. Fuel filter--
 - c. Fuel pump--
 - d. Carburetor--
 - e. Fuel line--
 - f. Air cleaner--
4. Describe the fuel pump operation during the inlet and outlet strokes.
 - a. Inlet stroke
 - b. Outlet stroke

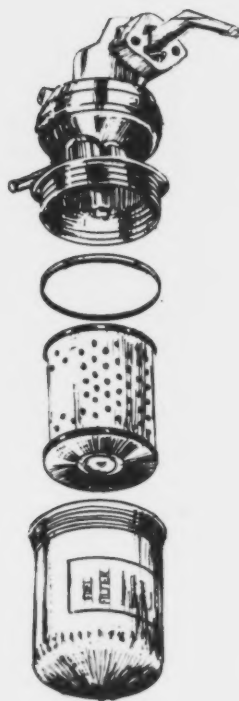
5. Identify the following types of fuel filters.



a. _____



b. _____

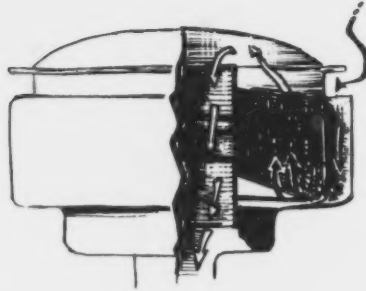


c. _____

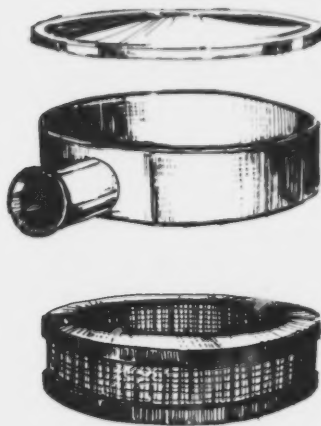


d. _____

6. Identify the following types of air cleaners.



a. _____

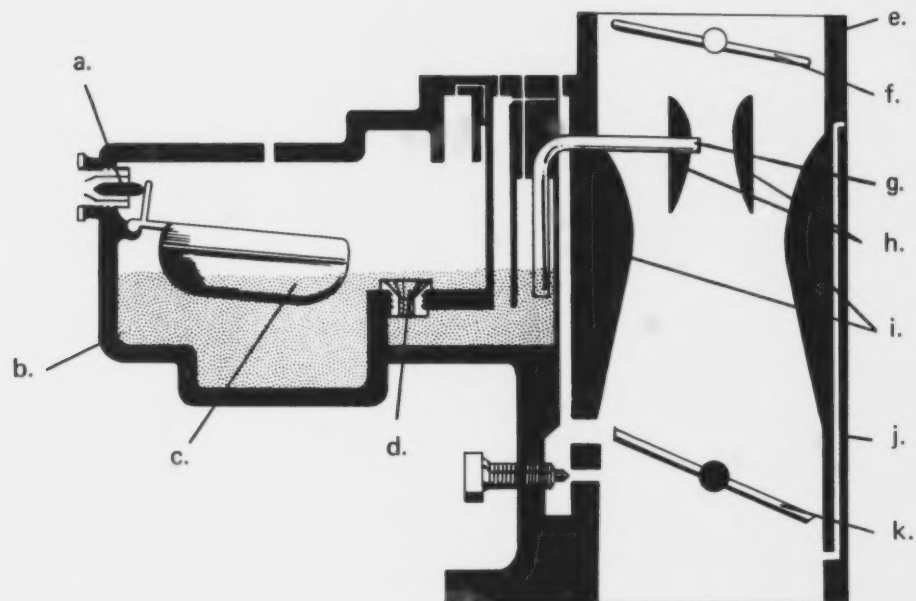


b. _____



c. _____ 124

7. Identify the parts of the carburetor illustrated below.



- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____
- g. _____
- h. _____
- i. _____
- j. _____
- k. _____

8. Match the carburetor systems on the right with the correct use.

- | | | |
|----------|---|----------------------------|
| _____ a. | Provides fuel delivery during operation with the throttle partly to fully opened. | 1. Float system |
| _____ b. | Provides extra fuel for normal starting | 2. Idle system |
| _____ c. | Provides a richer mixture for cold engine starting and operation | 3. Main metering system |
| _____ d. | Temporarily provides extra fuel necessary to overcome the leanness caused by rapid throttle opening | 4. Power system |
| _____ e. | Reduces fuel for high gear operation | 5. Accelerator pump system |
| _____ f. | Maintains a given depth of fuel in the float bowl | 6. Choke system |
| _____ g. | Provides fuel delivery during closed or nearly closed throttle | |
| _____ h. | Provides extra fuel for auxillary equipment operation, such as air conditioning | |

9. Match the types of gasoline additives on the right to the correct purposes. Purposes continue on next page.

- | | | |
|----------|--|------------------------------|
| _____ a. | Indicates location of fuel leaks | 1. Dye |
| _____ b. | Prevents rust and corrosion in storage tanks, lines, and fuel systems | 2. Carburetor detergent |
| _____ c. | Prevents pre-ignition | 3. Anti-icing agent |
| _____ d. | Indicates presence of antiknocks; identifies various makes or grades of gasoline | 4. Antirust additive |
| _____ e. | Prevents fuel deterioration of rubber hoses and gaskets | 5. Antioxidant additive |
| _____ f. | Prevents formation of ice in storage tanks, lines, and fuel systems | 6. Deposit modifier additive |
| _____ g. | Prevents gum formation during the normal life of the fuel | 7. Antiknock compound |
| _____ h. | Combats surface ignition and spark plug fouling | |

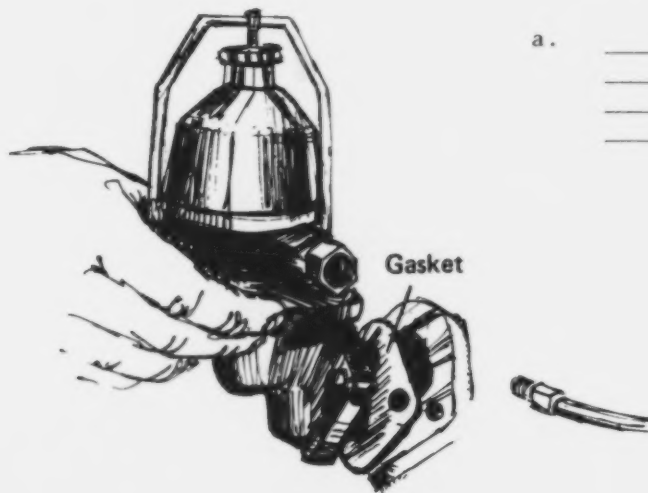
- ____ i. Provides lubricant for carburetor throttle valves
- ____ j. Prevents lead deposits from accumulating on inside of carburetor

10. Discuss fuel injection.

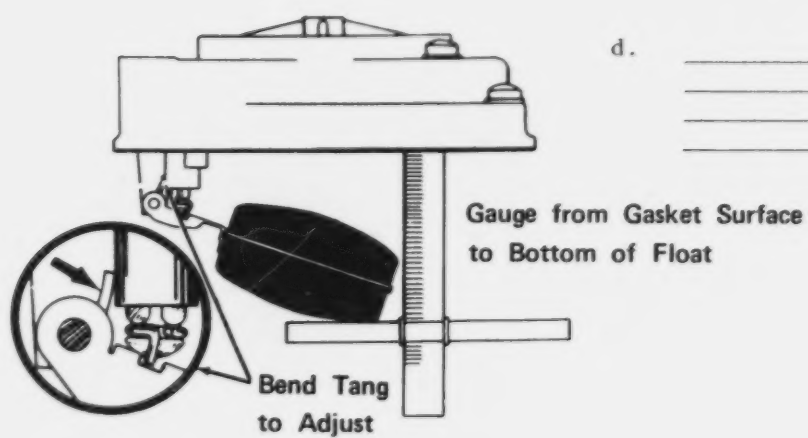
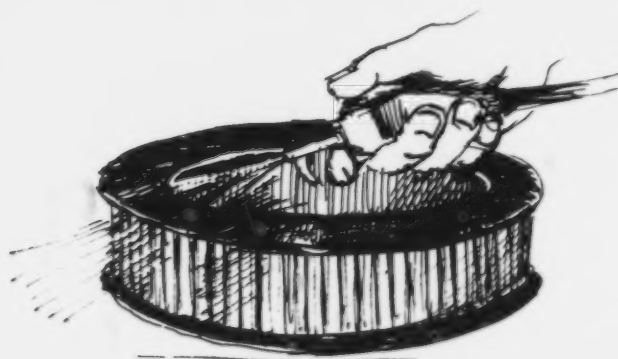
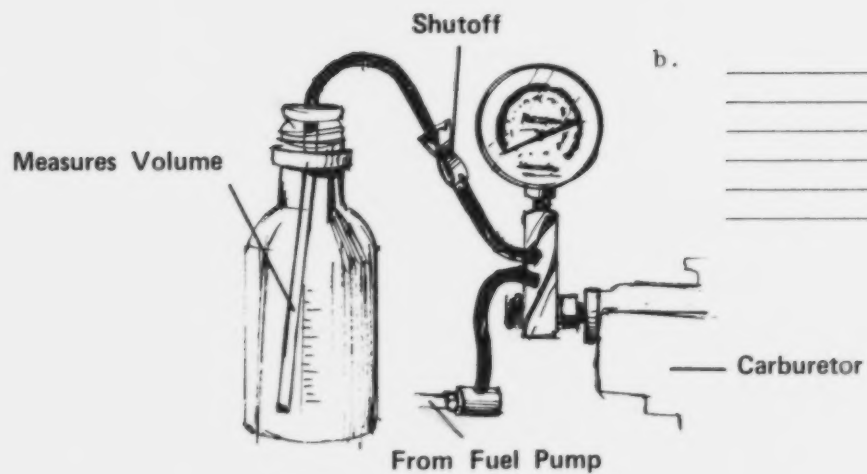
11. Name types of fuel injection systems.

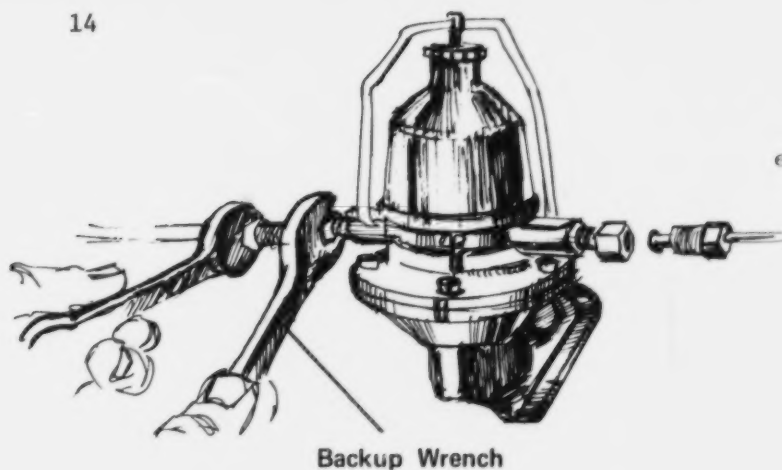
- a.
- b.
- c.
- d.
- e.
- f.

12. Explain what is being done in each illustration.



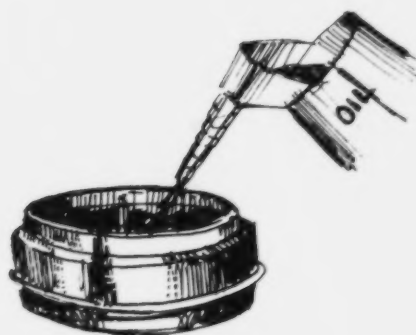
a. _____





Backup Wrench

e.



f.

13. Stop. Have your instructor evaluate your Pre-Test and mark the areas below which require additional study.

Refer to Information Sheet, Sections:

___ I	___ VII
___ II	___ VIII
___ III	___ IX
___ IV	___ X
___ V	___ XI
___ VI	

You came here from LAP Step 2. If any of the above areas is checked continue to LAP Step 3. Otherwise, proceed to LAP Step 6.

FUEL SYSTEM
UNIT V

LAP ASSIGNMENT SHEET #1--FUEL SYSTEM

NAME _____ SCORE _____

1. Write the purpose of the fuel system by completing the following statement.

To supply a _____ mixture of _____ and _____ to the engine
_____ to meet all driving _____.

2. Match the following terms to their correct definitions.

- | | | |
|----------|---|----------------|
| _____ a. | Restriction in the carburetor which makes the air speed up, causing a high vacuum | 1. Atomization |
| _____ b. | Correct proportions of fuel and air for good combustion | 2. Venturi |
| _____ c. | The breaking of a liquid into tiny particles or globules to aid evaporation | 3. Metering |

3. Match the components of the fuel system on the right to their correct purposes.

- | | | |
|----------|---|----------------|
| _____ a. | Carries fuel from fuel tank to the carburetor | 1. Fuel tank |
| _____ b. | Pumps fuel from fuel tank to the carburetor | 2. Fuel filter |
| _____ c. | Stores fuel for engine use | 3. Fuel pump |
| _____ d. | Mixes air and fuel in the proper proportion for a combustible mixture | 4. Carburetor |
| _____ e. | Prevents dirt and foreign matter in the fuel from entering the carburetor | 5. Fuel line |
| _____ f. | Filters grit and dust from the air entering the carburetor | 6. Air cleaner |

4. Describe fuel pump operation by completing the following statements. The answers are hidden in the word search below. Words are written vertically, horizontally, and diagonally, forward and backward.

```

D B S D O N F C M
T I H H U R U H I
A D A L U U E N G
P N E P O T L B V
X I U C H E C K A
E M G R T R Q F C
P J Y E V L A V U
Z F S P R I N G U
A C W K E N V S M

```

A. Inlet stroke

1. _____ flexes downward, forming a _____
2. _____ valve opens
3. Fuel is drawn into _____

b. Outlet stroke

1. Diaphragm is pushed upward by _____
2. Inlet _____ valve is forced _____
3. _____ valve is forced _____
4. _____ is forced out of pump

5. Identify types of fuel filters by selecting the correct names.

In-line
Bowl

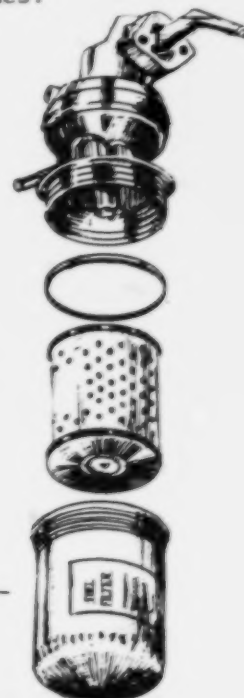
Carburetor inlet
Disposable inlet



a. _____

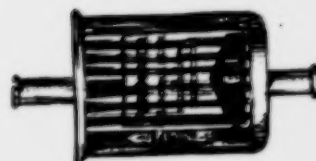


b. _____





c. _____



d. _____

6. Identify the following types of air cleaners by selecting the correct name.

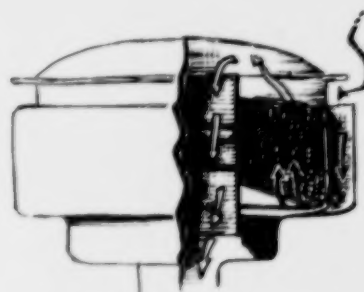
Oil bath

Paper element

Polyurethane



a. _____



b. _____

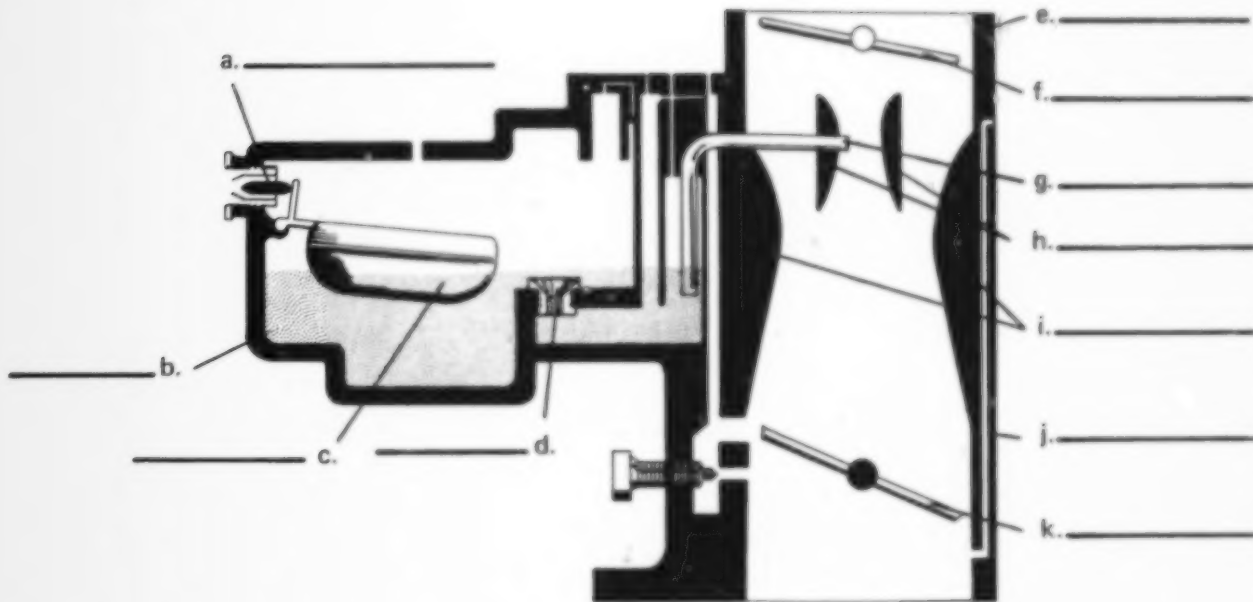


c. _____

7. Identify the parts of the carburetor illustrated below by selecting the correct names.

Air horn
Choke valve
Needle valve assembly
Float
Float bowl
Nozzle

Venturi
Throttle body
Throttle valve
Venturi cluster
Jet



8. Describe uses of carburetor systems by unscrambling the system names described below.

- | | |
|---|---|
| a. N I M A G R I N T E E M system --
_____ | Provides fuel delivery during operation with the throttle partly to fully opened |
| b. O H E C K system --
_____ | Provides a richer mixture for cold engine starting and operation |
| c. C L E A R O T R A C E M U P P system --
_____ | Temporarily provides extra fuel necessary to overcome the leanness caused by rapid throttle opening |
| d. T A F L O system --
_____ | Maintains a given depth of fuel in the float bowl |

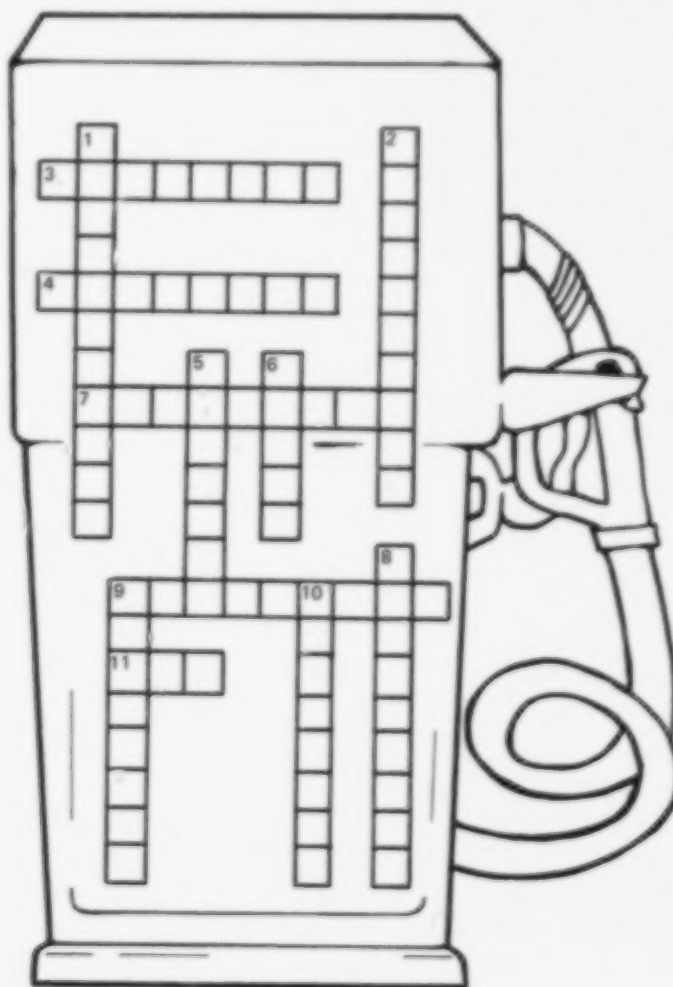
e. L I E D system --

Provides fuel delivery during closed or nearly closed throttle

f. W E P O R system --

Provides extra fuel for maximum engine power to supplement the main metering system

9. Describe the purposes of gasoline additives by completing the crossword puzzle below.



a. (3 Across) (9 Down) --

Prevents rust and corrosion in storage tanks, lines, and fuel systems

b. (8 Down) (10 Down) --

Prevents pre-ignition

- c. (11 Across) -- Indicates presence of antiknocks; identifies various makes or grades of gasoline
- d. (9 Across) (6 Down) -- Prevents formation of ice in storage tanks, lines, and fuel systems
- e. (1 Down) (9 Down) -- Prevents gum formation during the normal life of the fuel
- f. (5 Down) (4 Across) (9 Down) -- Combats surface ignition and spark plug fouling
- g. (2 Down) (7 Across) -- Prevents lead deposits from accumulating on inside of carburetor
10. Describe operation of fuel injection by completing the following statement.
- Fuel is injected under _____ directly into _____ or into intake air _____ instead of mixing with air to _____ prior to distribution.
11. Name variations of fuel injection systems by placing an "X" beside each correct variation.
- _____ a. Mechanical
 - _____ b. Laser
 - _____ c. Electronic
 - _____ d. Combustion chamber injection
 - _____ e. Vacuum flow injection
 - _____ f. Port injection
 - _____ g. Overhead cam injection
 - _____ h. Constant flow injection
 - _____ i. Timed injection
12. Stop. Have your instructor evaluate your Assignment Sheet and check the areas that require additional study.

Refer to Information Sheet, Sections:

_____ I	_____ VII
_____ II	_____ VIII
_____ III	_____ IX
_____ IV	_____ X
_____ V	_____ XI
_____ VI	

If any of the above areas is checked, study the required sections and then go to LAP Step 5. Otherwise, proceed to LAP Step 6.

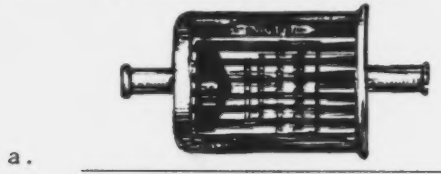
FUEL SYSTEM
UNIT V

LAP ASSIGNMENT SHEET #2--FUEL SYSTEM

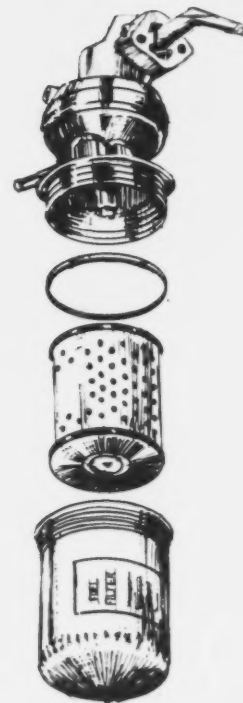
NAME _____ SCORE _____

1. Write the purpose of the fuel system.
2. Define the following terms.
 - a. Atomization --
 - b. Venturi --
 - c. Metering --
3. List one purpose for each of the following components of the fuel system.
 - a. Fuel tank --
 - b. Fuel filter --
 - c. Fuel pump --
 - d. Carburetor --
 - e. Fuel line --
 - f. Air cleaner --
4. Describe the fuel pump operation during the inlet and outlet strokes.
 - a. Inlet stroke
 - b. Outlet stroke

5. Identify the following types of fuel filters.



b. _____

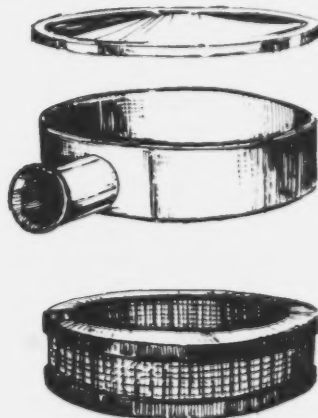


c. _____

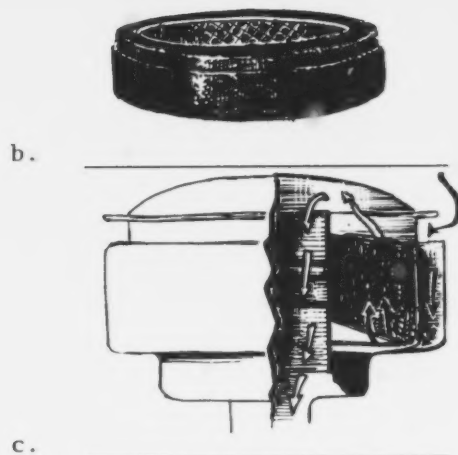


d. _____

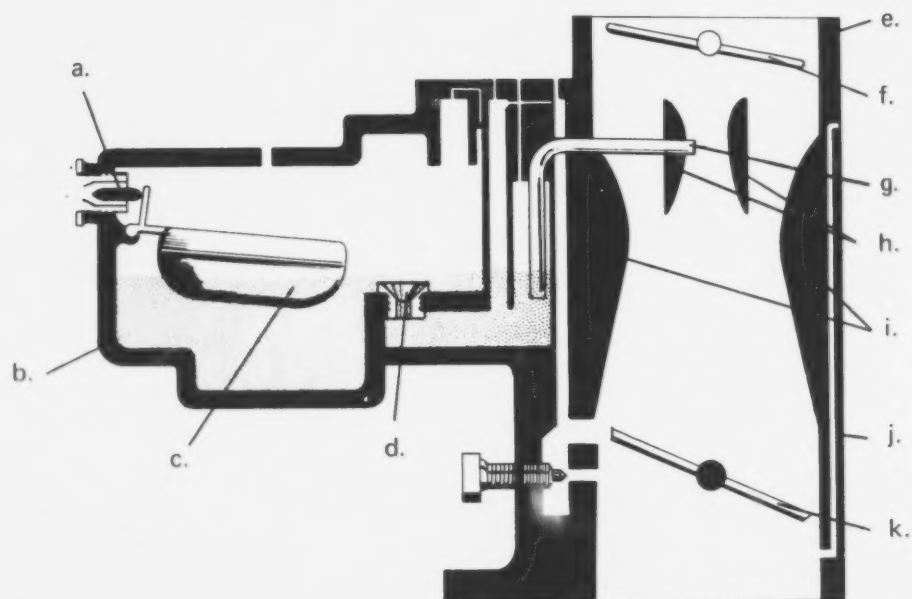
6. Identify the following types of air cleaners.



a. _____



7. Identify the parts of the carburetor illustrated below.



a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

k. _____

8. Describe the use of the carburetor systems listed below.

- a. Float system -- _____

- b. Idle system -- _____

- c. Main metering system -- _____

- d. Power system -- _____

- e. Accelerator pump system -- _____

- f. Choke system -- _____

9. Describe the purpose of the following types of gasoline additives.

- a. Dye -- _____

- b. Carburetor detergent -- _____

- c. Anti-icing agent -- _____

- d. Antirust additive -- _____

- e. Antioxidant additive -- _____

- f. Deposit modifier additive -- _____

- g. Antiknock compound -- _____

10. Discuss fuel injection.

11. List variations of fuel injection systems.

- a.
- b.
- c.
- d.
- e.
- f.

12. Stop. Have your instructor evaluate your Assignment Sheet. If your instructor is satisfied with your performance, continue LAP Step 6. If additional study is required, discuss a study program with your instructor. Once you have completed that program to your instructor's satisfaction, continue to LAP Step 6.